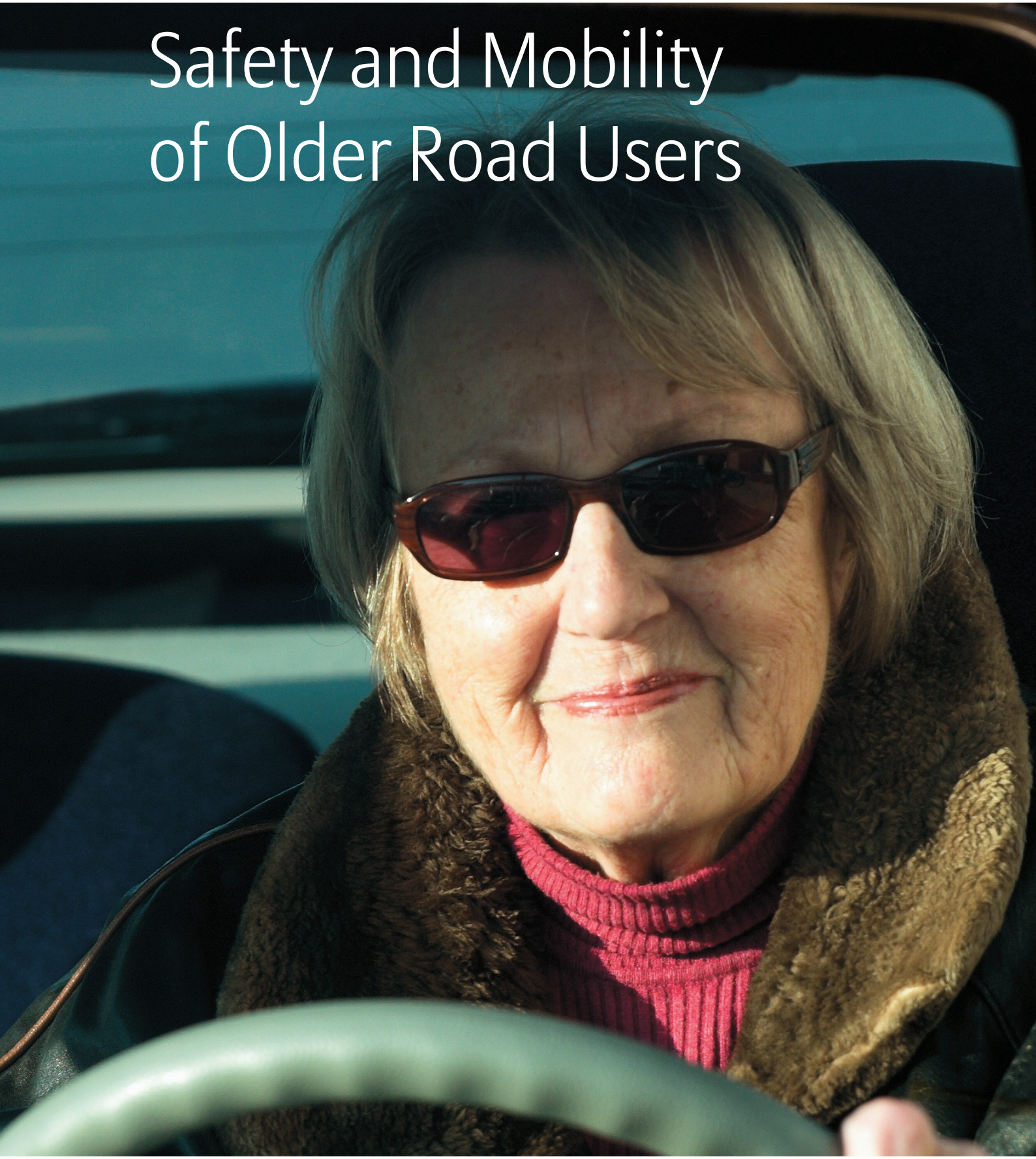
Allianz

Safety and Mobility of Older Road Users



A study of Allianz Deutschland AG with support of the European Transport Safety Council.

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Safety and Mobility of Older Road Users

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Published by
Allianz Deutschland AG, Munich

February, 2009

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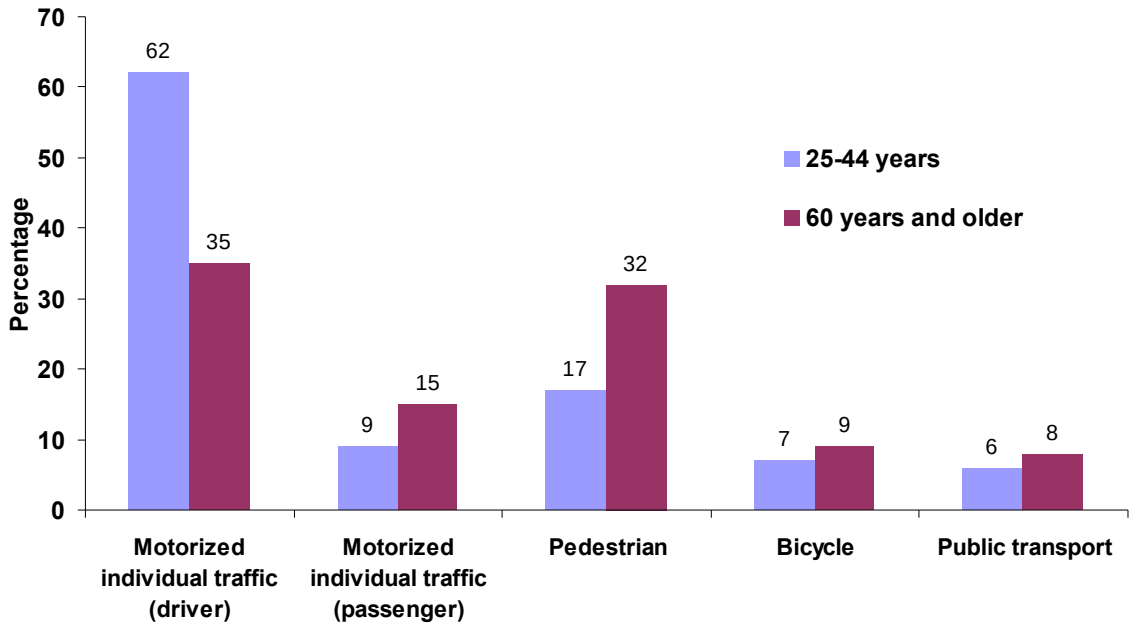
Demographic changes and older road users – since the millennium no other aspect of traffic safety work has been such a focus of public attention, and hardly any other subject has been such a focus of international research. Over the past ten years the conclusions of many important studies have shed additional light on the quality of life of older adults, where mobility and safety intersect. Contemporary studies on the safety of older people are almost invariably based on interdisciplinary approaches that include gerontology, urban planning, and accident theory. And yet a look at the public's perception will show that reporting on older road users is for the most part limited to the greater or lesser risk they represent as drivers. But elderly drivers, at least, do not held the biggest portion of mileage – in Germany, a country with high motorization, they account for no more than ten percent of kilometers traveled.

Europe is aging – The suburbs are getting older

First the facts. The world's population is involved in a process of aging which is not limited to the western industrialized countries. Experts predict that the proportion of older people (over age 64) in the Member States of the European Union will increase from approximately 17 percent in 2008 to around one-third in 2050. That process affects all countries regardless of their cultural or religious background, including southern and eastern Catholic countries. The share of older people in Germany, at 20 percent, is well above the European average, and that lead will be maintained in the future. There are multifaceted socio-cultural and economic reasons for this shift in the age pyramid, but their effects on the structure of urban development and on the need for mobility are obvious. Experts assume that the areas that will age are precisely those rural and suburban regions that will need the greatest possible choice among transport modes if older people are to maintain their (current) demand for mobility – and this consideration does not even include any idea on how mobility will look like there in future.

There will be high rates of growth in the percentage of older people in regions that are already suffering from the withdrawal of public transport providers for economic reasons and from other infrastructure-based disadvantages for the provision of services which result in a

need for mobility. It is already apparent in Germany today that most older adults rely on cars to get around, although a comparatively high percentage of them also walk (in contrast to young people). When comparing transport modes, older people are most likely to say that public transport does not meet their needs or fulfill their demands for convenience and (objecttive as well as subjective) safety. Various experts have expressed the opinion that this mobility pattern will not decisively change. It is thus clear that older people are dependent on motor vehicles today and will continue to rely on them in the future.



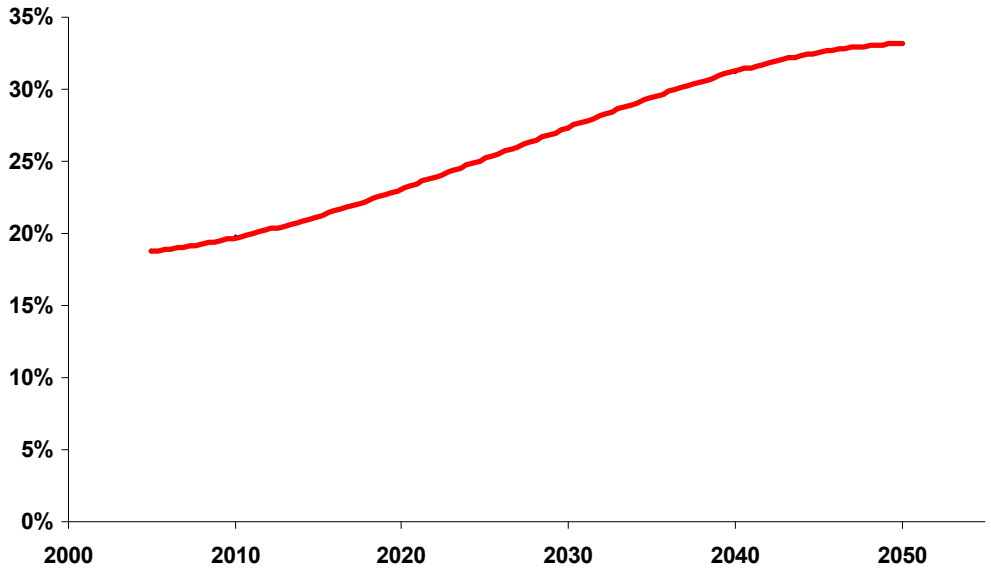
Trips by the main transport modes in Germany
(Continuous Mobility Survey by the German Federal Government, *Mobilität in Deutschland*, MiD, 2002)

In addition to the mobility structure that has been described, a series of key data on car ownership indicates an increase in the percentage of older people who own cars, although in some cases it is only cohort-specific, or in other words related to an individual generation, and saturation effects can be expected as succeeding generations come along. According to the German Federal Road Transport Office [*Kraftfahrtbundesamt*], the fastest growth is in the percentage of private cars registered to older people and the percentage of older people with access to cars. There are also obvious increases in the driver's licensing rate as older people age. Motorized mileage traveled is more varied. It is growing (although at a relatively low level), particularly for older women, who use to be more automobile today. Some young age

groups are showing a decline; overall the data on (motorized) mileage by all population groups is stagnating. The most recent data on mobility in Germany (MiD, 2008) is expected in 2009. According to what those reference values show, the critical attitude toward older drivers is not inappropriate on initial view.

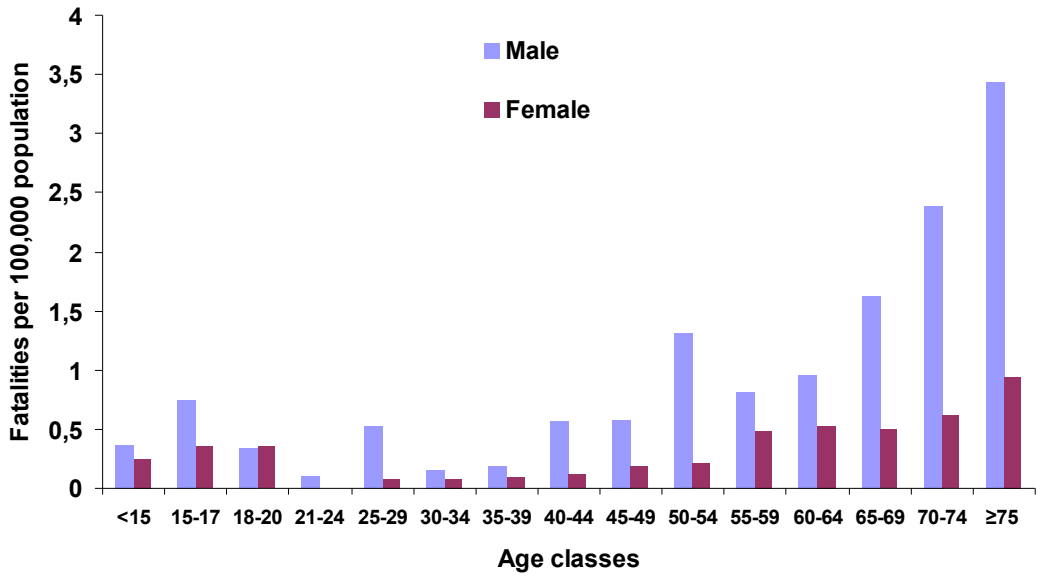
Older people are dying disproportionately on Europe's roads

The first overview in this study, to which the European Transport Safety Council contributed the European crash data (see section 4.2 for details), shows that older people (age 65 and over) have higher mortality rates than all younger people (under age 65). The risk of being killed on Europe's roads is 16 percent higher for older people than it is for younger people. According to the age trends for the individual Member States, it is anticipated that the share of older people on all traffic fatalities in the EU-27 will increase from almost one-fifth today to one-third (see Annex 1 for definition of EU-18, EU-27, etc.). The percentage of older people among the fatalities of all ages in Germany is about 23 percent, which is greater than their share of the general population, in contrast to the large group of all middle-aged adults from 25 to 64 years of age.



Projected traffic fatalities of the elderly as a percentage of the traffic fatalities for all ages in the EU-27 through 2050 (European Transport Safety Council, 2008)

A closer look at the crash situation that occurs shows the following: Most older people die as the "weaker" road user, i.e., as pedestrians and bicycle riders, and also as passengers in motor vehicles – two-thirds of all older people who are killed in Germany, compared with one-quarter among those 25 to 64 years old. In that regard, safety for older people all over Europe primarily means pedestrian safety, since 40 percent of all pedestrian fatalities – a shocking 49 percent in Germany – are older people. Given those figures, one thing must be made perfectly clear: Based on the percentage of people who are primarily at fault in crashes in Germany, older pedestrians themselves bear very little responsibility for their own casualties, as shown by the primary at-fault rates (the ratio of the person who is primarily at fault to everyone involved in a crash within each age class). Finally, regardless of the way in which they use the road, older people tend to have accidents during the day and in urban areas and older men are more at risk than older women, particularly as bicycle riders. In contrast, older women are killed more frequently as older passengers in motor vehicles. But, without regard to gender, it may be said for Germany that older people have a higher likelihood of dying as passengers than younger people. Even the multi-year average shows that the death rates for older passengers (per 100,000 population) are consistently higher than for middle-aged adults.



Bicycle fatalities in Germany by age and sex per 100,000 population of the age and sex class, 2006
(Database: StBA, 2007)

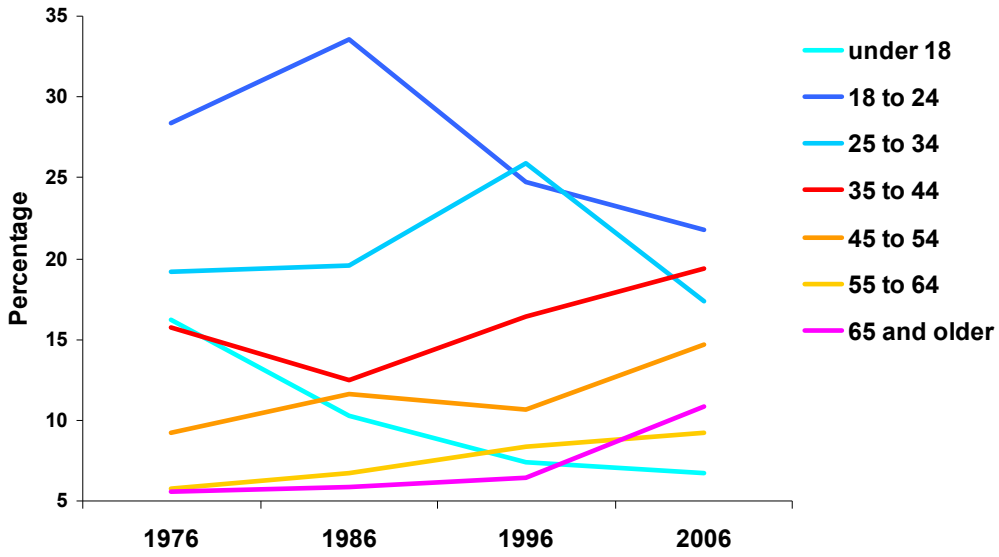
Older people have a greater likelihood of dying based on all types of road use than middle-aged adults do. The greater vulnerability of older people is the reason for that greater likelyhood of dying under the same circumstances in a crash. This multi-year trend also shows that, although older people, like other people, do benefit from falling crash numbers and therefore from improved safety, they are still at a disadvantage since passive safety measures consistently offer them less protection.

Older people cause disproportionately fewer crashes

While older road users are disproportionately the "victims" when measured in terms of population based accident ratios, they are clearly under-represented among those who cause crashes. That begins with people involved in crashes: Only 10 percent of all people involved in crashes with bodily injury (any type of road use or transport mode) in Germany are over age 64, while 65 percent are between 25 and 64 years old (their share of the total population is 55 percent). Also interesting is the percentage of each age involved in all primary at-fault crashes: 10.8 percent of all people who are primarily at fault in an injury crash (all types of road use) are older. Among car drivers who are primarily at fault, the level is 11.8 percent.

The trend for those percentages over the last decade shows a considerable increase for older people. But a closer look shows that this deterioration also affects most other adult age classes. All road users over age 35 have deteriorated in the past few years in Germany, while road users under age 35 have improved. The same applies to the trend for the percentages by age of car drivers who are primarily at fault. Finally, the older elderly (over age 75) cause only 4 percent of crashes with bodily injury, although they make up 8 percent of the population in Germany.

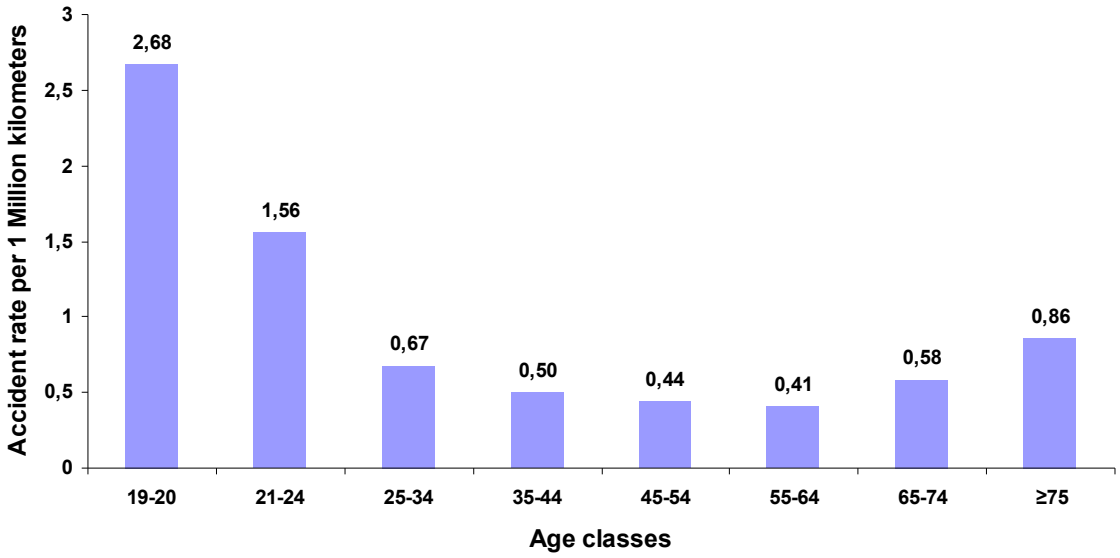
Crash pattern changes after correcting for mileage. Vehicle crash rates increase, particularly for the older elderly ($\geq$ 75 years). But this also requires a closer look. The younger elderly still do better than young drivers and even somewhat better than people in the 25-34 are group, with whom they are comparable. And the crash rates for older people are half as high as those for people in the 21-24 are group (German crash data from 2002 was used for methodological reasons; the results for the crash data for 2007 are substantially the same).



Percentage of people primary at fault in all injury crashes for all types of road use over time, divided into four middle-aged groups in Germany (Database: StBA, 1977-2007)

Two phenomena are the primary contributors to this. First, young drivers, because they make up a low percentage of the population, contribute less to the total sums of vehicle mileages driven during the year than is generally assumed. Second, older people have also been shown to avoid driving in situations that promote crashes. Studies in other countries also show that when comparing motorized vehicle crash rates for different age groups it is not sufficient merely to consider the overall mileage. Rather, to allow a fair comparison, only groups that travel the same, given in mileage, should be compared with each other. But such calculations are rarely found in Germany.

There is no denying that when older car drivers are involved in a crash they tend to be primarily at fault. There is almost no difference between the sexes. In that respect, it is imperative to analyze all circumstances, which help to describ the accident. On the other hand, older drivers are distinguished by compensatory mechanisms that as a matter of principle help them to avoid crashes. A separate analysis by the German Federal Bureau of Statistics for AZT Automotive GmbH – Allianz Center for Technology showed that the percentage of older drivers who are primarily at fault in car crashes with bodily injury in the dark, at twilight, or under adverse road conditions is much lower than it is for younger drivers. Additional research indicates that older car drivers are well aware of the particular hazards they face.



Crashes with injured and major material damage in which car drivers were primarily at fault, by age, per 1 million kilometers total annual mileage driven in private cars, 2002 (Database: StBA, 2003)

Older drivers of motor vehicles are said to exhibit a characteristic pattern of errors. As they age, they increasingly have problems coping with complex situations and reacting quickly. This primarily involves cognitive steps in information processing. Officially recorded driver errors for injury crashes show that older people make more mistakes related to right-of-way, priority, and turning than younger groups of drivers do; this pattern is also seen in the mistakes made by older bicyclists. On the other hand, this study showed that the issue of how this pattern is related to age appears to be far from resolved. Looking at crash types according to the age of all drivers who are primarily at fault in injury crashes, it will be seen that the ranking of the crash types is almost equal for all adults over age 35. The turning/crossing an intersection crash is by far the most frequent for all car drivers, and the further ranking of other crash types is also similar – the pattern of crashes among the adult age groups and seniors (not including novice drivers) is probably not as different as most people conclude. Problems in handling complex driving tasks become more acute with age, whereas failure to comply with speed limits and alcohol offenses are also a factor for younger people.

Older drivers benefit from driver assistance systems

It has been shown based on a random sample of collision claim data of Allianz Versicherungs-AG that it is primarily older drivers whose car crashes could have been influenced (addressed) by assistance functions and possibly prevented or might have had fewer consequences. Active

emergency braking, intersection assistance, particularly in left-turn situations (although not yet being series produced), and other functions such as lane departure warning or adaptive cruise control (ACC) have been recognized as important in an analysis of injury crashes. In the case of collisions involving only material damage, it was seen that older people would above all benefit from parking assistance systems. But the random sample of insurance claims also showed that if loss events involving older people are further divided into additional age groups, the situation appears to be stable for the most part. There was no difference among car crashes caused by 65-year-olds, 75-year-olds, and 80-year-olds. This conclusion about insurance coincides with the findings of the German Federal Highway Research Institute, whose most recent publication on the structure of crashes involving older people referred to this stability. Therefore, the hypothesis may be stated that the increase in the crash rate above age 75 tends to be due more to lower mileage traveled than to other deficiencies in the driver. But further research on the question of the drivers' aptitudes in the older elderlies is still needed.

Voluntary advisory services and examinations

A series of disorders such as neurological problems, diabetes, dementia, and cataracts and the intake of medications such as antidepressants or benzodiazepine, both of which correlate with age and could increase the risk of crashes, offers reasons to help eliminate the concerns of older drivers about voluntary measures such as mobility checks, examinations by an ophthalmologist, or traffic safety courses. However, all of the relevant considerations related to crash statistics also clearly show that there is no justification for a general senior age limit on driver's licenses and general senior driver examination requirements in the absence of specific case related reasons.

1 Introduction – Mobility and safety in an aging society

"*Eighty-four-year-old completely confused at the wheel*" (SZ, 2008), "*90-year-old drives the wrong way on the freeway … officers don't believe their eyes*" (PolPSüdH, 2005), or "*Speeding granny wrecks four cars in 14 minutes*" (Bild, 2008) – Whenever a crash involves a driver who is older than the active, leisure-oriented "best-agers" who are so prominent these days, older than the well-off "new old," the incident quickly becomes a story that "published opinion" find well worth passing on. As goes published opinion, so goes media reporting. But public opinion, including committees and boards, the political world, and technical fields, driven by need for everyday political action, also focus all too often on the question of the risk posed by "older people at the wheel." Every crash serves to fan the flames of the debate about driver's licenses. Whether the 84-year-old – although perhaps not in the case above – has not been driving anymore but used an available vehicle while in a state of confusion; or the fact that careless driving is merely correlated with age (and tends to be typical of young people) and otherwise has been scientifically proven to be based on personality traits of the driver and can affect any age; or the fact that the main cause for driving the wrong way on the freeway is the amount of alcohol the driver has consumed; or, finally – to anticipate the results of a pilot evaluation by Allianz – the fact that it appears that a 50-year-old at the wheel is at greater risk from a heart attack (more on that in Chapter 5) – all of these factors are simply not further discussed when attempting to reconcile public and published opinion. Older road users – this issue is still a preoccupation in our society, particularly from the viewpoint of the risk posed by older car drivers.

Science has certainly found that it is more likely that the older elderly will experience physical and cognitive abnormalities that can cast doubt on their competence to drive (*driver aptitude*), either at all or subject to certain parts, and that this subsequently lead to a higher probability to get involved in an accident. It is also true for active use of a motor vehicle that as age increases it is more likely that drivers will be primarily at fault in any crash in which they are involved (expressed as the percentage of people who are primarily at fault out of everyone involved in traffic crashes). Chapters 4.1 and 5 will discuss the details. In reference to the available data on mileage in German private car drivers, an increase with age for all

crash rates can be discussed – but it is also undisputed that, based on the sum of all crashes in Germany, older people count for a far smaller portion in accident participation, or at-faults, than younger drivers, particularly when measured in terms of reference data such as population, the number of registered cars, or the licensing rate. For example, in 2006, of everyone primarily at fault in a car crash with bodily injury, only 4 percent were drivers over age 74, although they make up 8 percent of the population. Moreover, after correcting for car mileage traveled, the crash rates of older people are still in some cases lower than those of young drivers, depending on the subject of the statistics and the breakdown of the age groups. It is clear, however, that in terms of their share of the population older people are disproportionnately the victims of crashes (fatalities) when they use motor vehicles, primarily as passengers and "unprotected" road users, i.e., pedestrians and bicycle riders (see Chapter 4.1). In future, they will also have to be a focus of all efforts to improve the safety of older road users.

Unfortunately, the most recent general crash figures for Germany for 2007 and 2008 make it abundantly clear that the safety of older people remains on the agenda. The absolute number of casualties among road users over 65 rose 5.2 percent from the previous year, and the absolute number of fatalities remained unchanged in 2007, contrary to an overall downward trend (StBA, 2008). The share of older people (≥ 65) out of all fatalities in 2006 was 22.7 percent, although that age group accounted for only about 19.5 percent of the total population during that year. These figures are confirmed in principle by data from previous years. Moreover, the monthly statistics for Germany show that there was no substantial improvement in the safety of older people in 2008, either. At 13.1 percent (12.4 percent for the 65-74 group; 13.6 percent for ≥ 75), the decrease in the number of fatalities among people over age 64 between January and April 2008 compared with the same period for the previous year is far behind the decreases for other age classes, which are 20 percent for the 18-24 and 25-34 age groups and 25% for the 35-44 group. Due solely to a pronounced increase, instead of a decrease, of over 12 percent for people in the 45-54 group, the decrease in the number of fatalities among older people is equal to that of people for the 25-64 age group, at 13.2 percent.

Nonetheless, it is impossible to give an immediate answer to the question of whether the group of older road users could or could not benefit to the same extent from the safety improvements over the past few years as the other age classes. The time series of the

mortality rate (all road user fatalities per 100,000 population in the respective age class) over the past decade shows that the safety trend for older people is comparable to the trend for the middle-aged adult group (Figure 1). In contrast, the younger age groups, particularly those known as "young drivers," have experienced a gratifying downward trend, which reflects the intensive efforts on behalf of this group. The constant higher level in the trend for the mortality rate of older people compared with the middle-aged adults indicates the increased vulnerability[1] of older adults to dying as the result of a crash. The graphic also shows that the group of older road users faces the second greatest risk, even ahead of adolescents (15-17 years old).

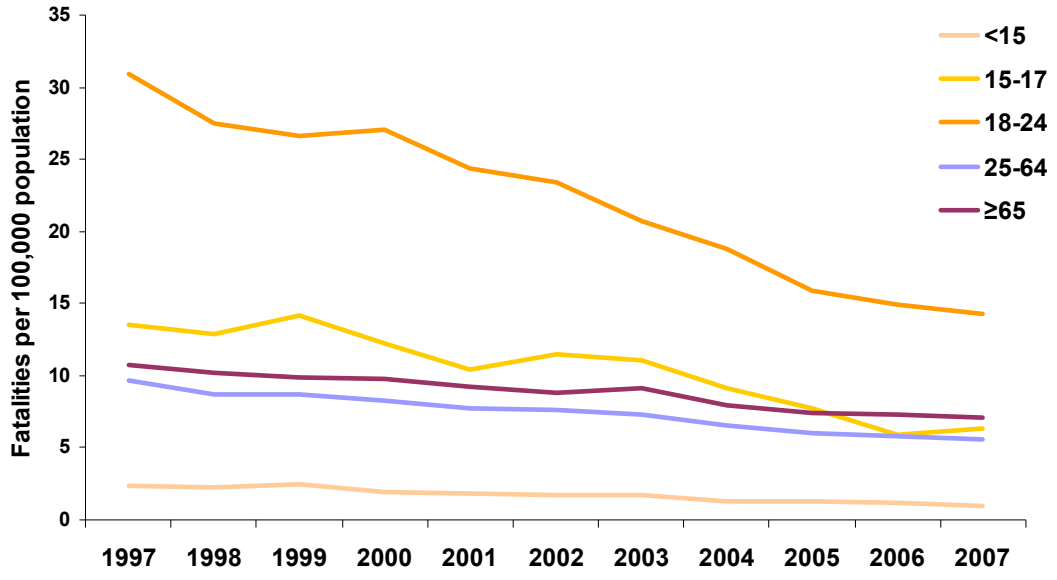


Figure 1: Trend for road traffic mortality rates (per 100,000 population in each age group) in Germany for all types of road use by age class, 1997 to 2006 (Database: StBA, 1998-2007)

An international comparison confirms the broad outlines of this situation. For example, the probability that an older person (≥ 65) will die in a traffic crash is much higher than it is for younger people (≤ 64), a pattern that with a few exceptions is relatively stable for the majority of EU-27 Member States. Chapter 4.2 provides more informations on this.

[1] To be quantified, for example, in the accident vulnerability index as the ratio of fatalities per casualties in an age class: 0.026 (older people) to 0.01 (ages 25-64) in 2007.

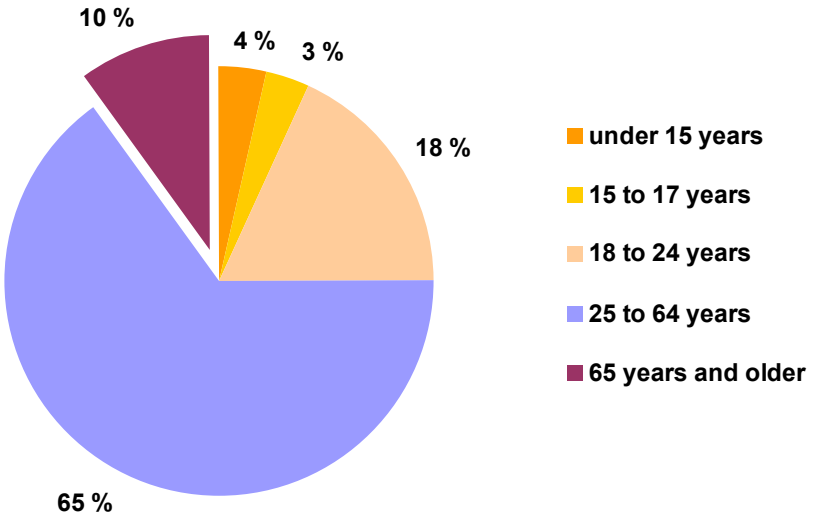


Figure 2: Percentage of people involved in traffic crashes with bodily injury (all types of road use) in Germany by age class, 2006 (Database: StBA, 2007)

To allow a detailed assessment, both the active and passive safety situation for older road users must – as for every other age group – be examined in relation to the type of road use, mobility according to length and frequency of trips and distances driven, and the percentages of people who are primarily at fault must also be contrasted. Chapters 3 and 4 provide additional information on this. Nonetheless, a statistical analysis for Germany shows that older people (≥ 65) are involved in only 10 percent of injury crashes (all crashes for all types of road use), while they account for about one-fifth of the population; the group of middle-aged adults (25-64 years) is involved in approximately 65 percent of such crashes but makes up only about 55 percent of the population. Young adults (age 18-24) account for roughly 18 percent of all crashes and roughly 8 percent of the population, making them the most critical group of road users (StBA, 2007; Figure 2).

As shown in Figure 3, the involvement rate (number of people involved in injury crashes per 100,000 population in the respective age group) for older people is 381, far less than half as much as that of middle-aged adults. In terms of the involvement rate of young drivers, they make up far less than one-quarter. The involvement rate over all age classes, when rounded, is approximately 742 per 100,000 population.

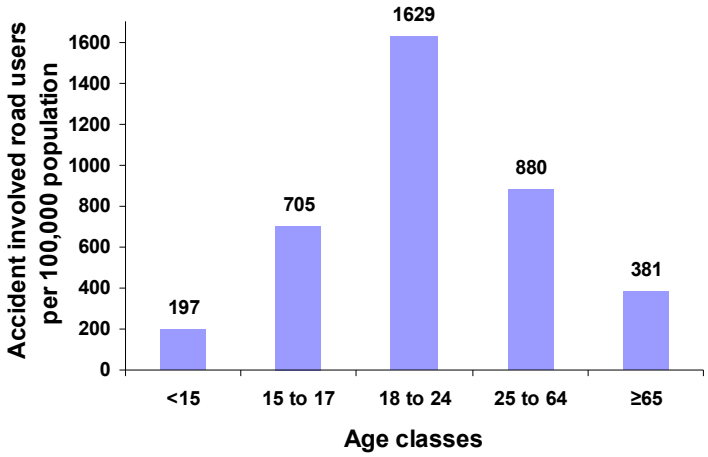


Figure 3: Number of people involved in injury crashes (all types of road use) per 100,000 population of the respective age class in Germany, 2006, rounded (Database: StBA, 2007)

The procedure to put accident data in relation to population data is subject to criticism, which will be discussed in Chapter 2. For example, the extent to which the percentage of older people in society is a reliable reference, particularly for accident data of motorized vehicles, is disputed; think of the question of actual use of the road by persons whose mobility is limited or the issue of how the percentage of people who are being cared for at home can be evaluated. Researchers have hitherto no reasonable information on which to base their corrections. Therefore, the number of car crashes in this report (Chapter 4.1; Annex 2) is also considered in relation to the number of registered cars and the number of car driver's licenses that have been issued, as well as car mileage traveled. In contrast, research will be needed in future to relativize the current absolute numbers of accident-involved over of all road users (namely including bicyclists and pedestrians) in terms of the mileage for each of those types of road use. Earlier analyses of this by Hautzinger et al. (1996) are available. But existing reference data, for example from the mobility surveys by the German federal government (see Chapter 3) suffer from the problem that they were not collected for the purposes of accident research and accident statistics.

Consideration of the generally hotly-contested issue of fault in older car drivers points in the same direction as findings about involvement in crashes for all types of road use. The most frequently motorized vehicle used by older people to get around is the passenger car. Motorized two-wheelers (and trucks, vans) are at least negligible. Of car users, the population-based primary at-fault rate for crashes with bodily injury and severe material damage in Germany is lowest for older people, aside from the group of younger people (Figure 4).

However, the trend over the past ten years also shows that the group of older people is the only one not to experience a population-related decline in its crash rate, although its absolute accident figures are nonetheless the smallest. Based on car mileage, the accident rate for seniors shows an increase, but it is still well below that of young drivers and even below the 25-34 age group, when – instead of all accidents with bodily injury plus all accidents with severe material damage – only all accidents with bodily injury are considered (see section 4.1). This makes it clear that even the accident rate correction for mileage driven by the group of car drivers older than 64 – which is so often mentioned – does not from the outset indicate a disproportionate potential threat by senior drivers that may not be acceptable to society.

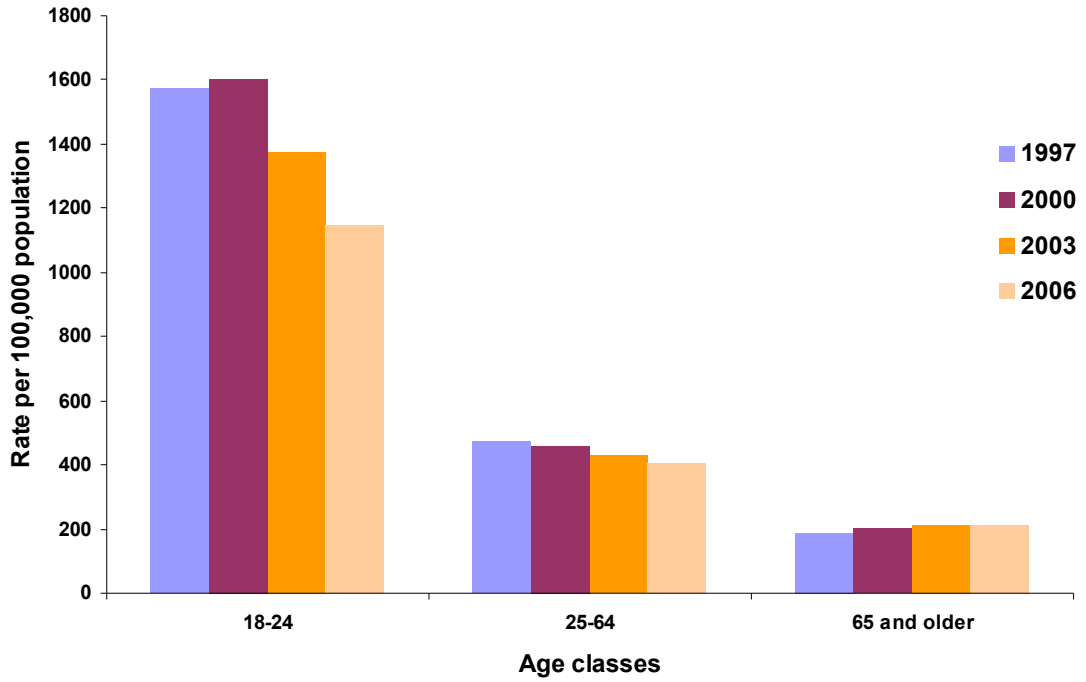


Figure 4: Accidents with bodily injury and severe material damage in which car drivers are primarily at fault by age class per 100,000 population of the individual age class in Germany, 2006 (Database: StBA, 2007a)

The introductory data above on the involvement of older people in traffic crashes clearly shows that it cannot automatically be concluded from crash statistics that there is a special need for restrictive measures *exclusive* to older drivers, for example changing the driver's license system in Germany, as the media often calls for based on spectacular cases. However, the issue is much more complex. The customary divisions into age groups which are used in accident statistics (see excursion on age classifications) provide only limited information about the actual risk for individual groups of drivers, particularly when age-correlated physical

and cognitive functions are involved. Chapter 5 will further explore this question about older people's competence or fitness to drive. Notwithstanding existing crash data, it certainly cannot be denied that in future – based on more in-depth research – there may be a specific need to implement certain measures to promote safety, including in laws on driver's licenses. However, older people *as a group* cannot be placed under general suspicion, due solely to their *calendar* age, of being a particular threat to public safety.

A second aspect of the above analysis of German federal statistics relates to the insurance industry and claims in the automotive sector. Official traffic crash statistics cover only crashes recorded by the police. The actual number of crashes is, however, much higher, as is the amount insurers spend on claims. The police recorded 2.26 million crashes in 2006, while there were 3.41 million automobile liability claims, not to mention claims under comprehensive policies (see GDV, published in StBA, 2007b). Average expenses for claims show a constant increase on multi-year average, as documented by the German Insurance Association. Loss events, which make up the lion's share, do not take center stage when experts are discussing the active or passive safety of older road users, but they are important from the viewpoint of insurance. In that regard, German insurers have for several years experienced an increase in total claims by older age classes. An ongoing project of the Association will provide further information. The findings on crashes in which older people are involved may differ depending on the geographic distribution of the market shares of the various automobile insurers, corresponding with the distribution of older inhabitants (residents) now, as well as in future, given in percentual changes in age distribution in forthcoming decades.

One thing must be emphasized: In any country, the public law requirement to avert risk focuses on the issue of "older road users" from the viewpoint of the public weal – in that respect, official accident statistics include only crashes with bodily injury and severe material damage, which is defined by the need to tow at least one motorized vehicle off of the public road. This is not the same as more broadly defined claims data of the insurers, which may be able to shed light on more far-reaching economic aspects, such as the issue of what potential improvement certain measures to avoid or reduce a damage could be, leading to a benefit, at least not for older vehicle owners alone. An empirical analysis of claims by Allianz Versicherungs-AG with regard to parking assistance (see Chapter 4.3) is just one example of this.

Excursion: The age classifications

There is relative consensus in the literature on transportation science concerning the age limit of 65 for defining the group *older people*, although that limit can appear very different based on the individual issue concerned. Divisions into age categories are often based solely on the practicalities of random sampling, for example contrasting people under age 50 with people over age 50 in perception experiments. On the other hand, very different age classifications may be needed for different psychological, medical, or economic and social aspects. For example, the age-related decrease in visual functions that are relevant to driving performance actually appears at a much younger age. Terms like the "new old" or "best agers" are not helpful for safety research, since they ultimately – in accordance with an American convention – describe only a narrowly-defined generation group and its socio-cultural background. Sociologists and gerontologists agree that the highly mobile and financially powerful younger elderly who are referred to by those terms, most of whom have retired since the 1990's, represent only a temporary phenomenon; in the future they will give way to more widespread poverty among the elderly. Finally, a subdivision, occasionally used by WHO (45-60, 61-75, 76-90, 90-100, 101+) is not useful for research into traffic saftey and above all does not reflect the driver characteristics of younger and older senior ages.

The ≥ 65 limit has endured in international traffic safety research. It is subdivided into the younger (65-74) and older (≥ 75) elderly, because accident data shows a change from the mid- to late seventies that can be clearly described. This report therefore uses those age classes, which are also established in German accident statistics[2] of the Federation according to the German Road Traffic Accident Statistics Act [*Strassenverkehrsunfallstatistikgesetz*, StVUnfStatG] and of the German states, in EU crash statistics, and in the majority of the research literature (Figure 5):

[2] Depending on the subject, crash data is available in age classes that have been broken down differently, and, as a matter of principle, additional subdivisions may be shown by the German Statistical Office. The age classes in the table that is presented are also – particularly in middle-aged adults – provided in greater detail in official statistics (divided into either 5- or 10-year levels). The elderly are usually divided into two groups as described above, and for some subjects divided into three groups (65-69, 70-74, and ≥ 75), with selected data available for all age levels. This table is intended to show only the overarching age definition of societal groups which is used as a basis for presenting the statistics.

Group	Calendar age
Small children	0-5 years
Schoolchildren	6-14 years
Adolescents	15-17 years
Young drivers/Novice drivers	18-24 years
Middle-aged	25-64 years
Elderly/Seniors	65 years and older
Young elderly/seniors	65-74 years
Older elderly/seniors	75 years and older

Figure 5: Definition of ages for societal groups

Given the amount of research in this area, these classes are also considered in greater detail depending on the issue involved. For example, for *younger* or *novice drivers*, each year of age causes a significant change in the occurrence of crashes. The senior road user traffic safety initiatives of the German Federal Minister of Transport have, at the request of the Ministry, been oriented to all people over age 50 and insofar include a broad spectrum of phenomena, problems, and requirements for solutions which are related to road traffic and drivers.

The English-language literature has for years used the terms "elderly drivers" for people in the 65-74 year age range and "older drivers" for drivers over 75. However, the terms are also used interchangeably. Given the number of different terms, it is therefore vital to document the numerical classification system in addition to the term that is used. This study refers to everyone over age 64 when it uses the terms "older people", "senior", or "elderly" without further description.

Age group divisions broken down into more subgroups beyond 65-74 and ≥ 75 which is used in gerontology can be useful for research on crashes in some cases, but it will not be the focus of this report, although the mobility of oldest elderly (approximately 80-100 years) or centenarians (≥ 100) certainly does exhibit interesting aspects – not least because the percentage of people over age 79 will double in the next 20 years in the European Community. The claims in the Allianz databases also include these age groups and can make a valuable contribution to the safety of these much older people in future traffic accident in-depth studies. Chapter 4.3 contains initial results for people over age 80.

The mobility and safety of older people are often compared in three ways in literature: The comparison of the group of *older people* with all age groups (including older people), the comparison of the group of *older people* (e.g., ≥ 65) with *non-older people* (e.g., younger than 65), and finally the comparison of the group of *older people* with other adult age groups, particularly the total group (exclusive young adults < 25); research on traffic safety in the strict sense prefers the last two. Documenting the safety situation for road traffic appears to indicate that a comparison of older adults primarily with middle-aged adults is useful, since younger adults (18-24 years) represent a group with very specific problems and phenomena in psychological and sociological terms (novice drivers, behavior typical of young people), which are clearly reflected in the crashes in which they are involved.

Road traffic in a changing society

In view of demographic trends, the experts have been discussing for a long time the effects that shifts in age structures will have on mobility and the occurrence of traffic crashes. Chapter 2 provides more detailed information on this. It is not just the societies of the European nations which are aging. Aging is a world-wide phenomenon; research on the safety of older people in road traffic has been done in the United States for more than three decades, and US American recommendations, for example, concerning road construction, have been widely discussed for a long time and in some cases are reflected in the political decisions of some US states. But the problem is acknowledged by the majority of other countries around the world, particularly in the Asian region, and even the newly-industrialized countries. Senior safety programs or measures to benefit older road users are also found there, and not just in highly-industrialized Japan.

Notwithstanding diverging model calculations from the past few years, the coming increase in the older age classes will be felt to a very great extent. The German federal government has predicted that the group of people over 64 will increase from 19.8 percent today to 33.2 percent in 2050 – almost one-third of the total population (Figure 6). Information about future mobility and the structure of accident data, if it can even be found, is less unanimous and less informative. Factors related to economic development or regional urban development structures appear to be too complex to be able to determine a uniform pattern. Chapters 2 and 3 describe this problem.

However, there is agreement with the assessment that the aging of the population in Europe will have a corresponding effect on the trend for crashes. The European Transport Safety Council (ETSC) has done calculations on the trend for the percentage of each age among road fatalities based on the Member States of the European Community (see Chapter 2). To the extent this initially involves a specific *shift* within the safety situation of age groups and less a general deterioration, the road traffic safety of older people seems to be a particular imperative of the political discussion and political decision-making.

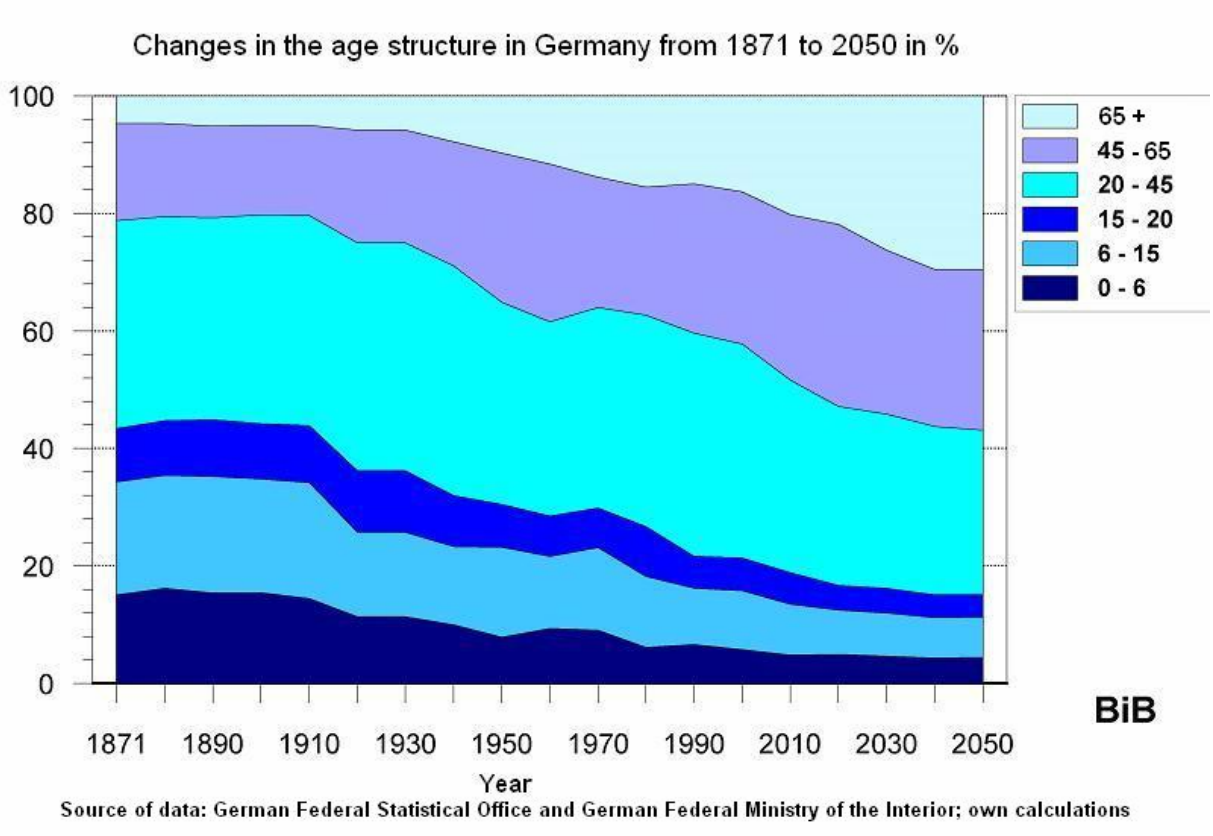


Figure 6: The population trend in Germany 1871-2050 (BiB, figure cited according to BMI, 2008, English by the authors)

In a good tradition of transport research a broad range of senior studies comes from the EU as well. In the technical discussion by traffic experts, the safety situation of road users is closely linked to research on mobility and to sociopolitical studies. Traffic safety research, traffic psychology, and gerontology have also been able to turn to a large number of research works. Tens of thousands of English-language monographs and publications in the technical journals show that such research is now on an equal footing with research on "young drivers." But

there have been many contributions in Germany and the EU – *Aged People Integration, Mobility, Safety and Quality of Life Enhancement through Driving* (AGILE, 2001), *Life Quality of Senior Citizens in Relation to Mobility Conditions* (SIZE, 2006), and *Trigger – Cooperation and Exchange Project to Promote the Mobility of Older People in Europe* (TRIGGER, 2005) of the European Commission, *Anforderungen Älterer an eine nutzergerechte Vernetzung individueller und gemeinschaftlich genutzter Vekehrsmittel* (ANBINDUNG, 2001) of the German Federal Ministry for Families, Senior Citizens, Women, and Youth, *Regionale und kommunale Strategien zur Aktivierung der wirtschaftlichen und gesellschaftlichen Potentiale einer alternden Gesellschaft* by the German Federal Office for Construction and Regional Planning (BBR, 2006), *Ältere Menschen im Kunftigen Sicherheitssystem Strasse/Fahrzeug/Mensch* (AEMEÏS, 2001) of the University of Bonn or *Alterstypisches Vekehrsrisiko* (KBA, 2008) for the German Federal Highway Research Institute BASt, *Perspektiven der Verkehrssicherheitsarbeit mit Senioren* (BASt, 2001), *Ältere Menschen als Radfahrer* (BASt, 1999), *Verkehrssicherheitsbotschaften für Senioren* (BASt, 2007) by the German Federal Highway Research Institute, *Freizeitmobilität älterer Menschen* (FRAME, 2006) by the University of Bonn for the German Federal Ministry of Education and Research, or finally the publications of the Eugen-Otto-Butz Foundation, *Mobilität älterer Menschen – Strategien zur Sicherung der Mobilität älterer Menschen* (Echterhoff, ed., 2005), *Kontinuität und Veränderung in der alltäglichen Mobilität älterer Menschen* (Hieber, et al., 2006), *Mobilitätssicherung älterer Menschen im Strassenverkehr* (Gerlach, et al., 2007), and *Liestungsfähigkeit und Mobilität im Alter* (Schlag, ed., 2008), to mention just a few.

Expert knowledge and the research environment these days are thus very sophisticated and unanimous with regard to the facts of the safety situation. That makes it even more surprising – at first glance – that it certainly is not an easy matter to present clear and concise solutions that are supported by all scientific experts and also by societal consensus. After a second glance, the problem of mobility and the safety of older people in the road traffic system appears more complex – and contradictory. This is the classic conflict of objectives with the quality dimensions of the system, as defined by the German police management academy (Hilse, 2002).

Any improvement in safety for some means a loss of economic efficiency for others, and increased mobility on the one hand leads to diminished safety on the other hand and vice versa. The debate about safety and lane use of two-wheelers back in the 1980's and the issue of road construction are just two examples of this.

Mobility and safety for all will always only be presentable as a compromise – a compromise in which all age groups and all user groups must fulfill their obligations. SIZE (2001) identified the carelessness and intolerance of other drivers as one of the five main factors that have a negative effect on the mobility of older people in Europe regardless of country. More mobility and safety for older people in road traffic therefore means calling for compromises – from everyone, but specifically from the non-elderly.

2 Demographic changes

Most European countries are affected by demographic changes in the age structure of their populations, in which society ages while the younger generation shrinks and population numbers decline. The main cause of that trend is the decline in birth rates. The reasons are thought to be higher employment rates for women, an environment that is hostile to children, and economic uncertainty (DIW, 2005). Greater emphasis on the individual, declining fertility in men, and reduced willingness to be personally limited by parenthood in a society that is oriented to mobility and flexibility are among the influencing factors (DIW, 2005). Employable age groups are migrating from several countries and regions in the European Union (EU). In addition to the decline in birth rates, the aging of the "Baby Boom" generation (born between 1946 and 1964) and a generally longer life expectancy will fundamentally change the population structures in many countries in coming decades. Figure 7 shows the EU anticipated increase in the percentage of older people (≥ 65 years) in the population for EU-27 through 2050.

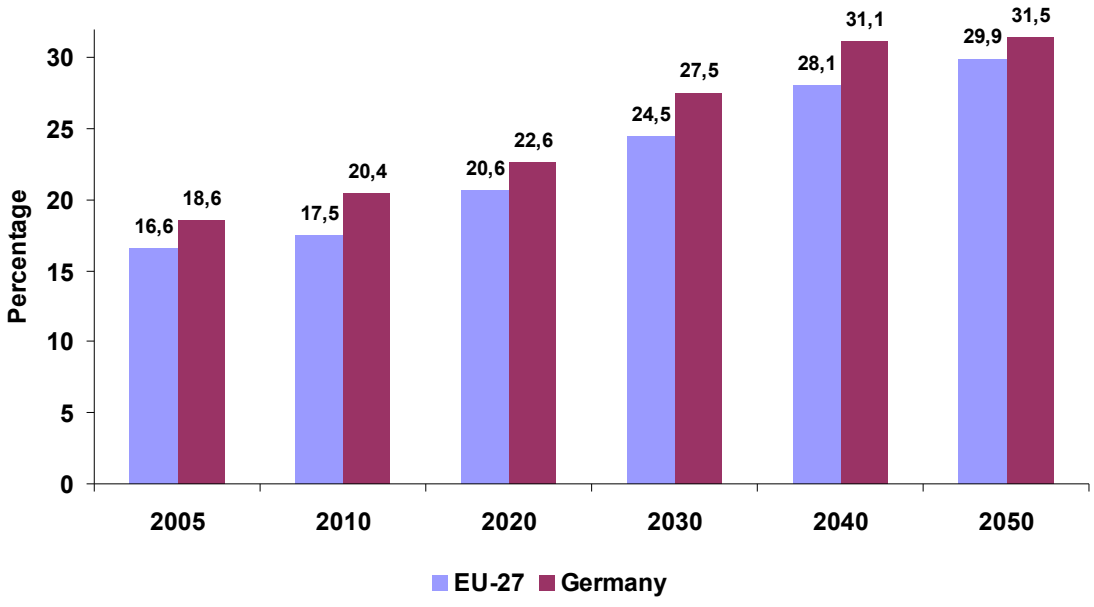


Figure 7: Predicted percentage of older people (≥ 65 years) in the population of the EU-27 (including Germany) and in Germany through 2050 (Eurostat, 2008)

The forecasts assume a considerable increase in the percentage of older people in the EU-27, with almost 30 percent of the population 65 years or older by 2050. That increase affects different European Union Member States differently (Figure 8). The population of the EU-27 was 495,394,000 in 2008, of whom 84,601,900 (17.1 %) were in the 65 and older group.

	2005	2010	2020	2030	2040	2050
Belgium	17.2%	17.5%	20.5%	24.7%	27.3%	27.7%
Bulgaria	17.2%	17.8%	21.7%	25.6%	29.2%	33.5%
Czech Republic	14.0%	15.5%	20.8%	23.6%	26.8%	31.0%
Denmark	15.0%	16.3%	20.0%	22.6%	24.7%	24.1%
Germany	18.6%	20.4%	22.6%	27.5%	31.1%	31.5%
Estonia	16.4%	16.9%	18.7%	21.2%	23.1%	25.7%
Ireland	11.2%	11.8%	14.7%	18.3%	22.2%	26.2%
Greece	18.1%	18.8%	21.1%	24.6%	29.2%	32.5%
Spain	16.8%	17.2%	19.8%	24.7%	31.2%	35.7%
France	16.5%	16.8%	20.7%	24.2%	26.8%	27.3%
Italy	19.5%	20.5%	23.3%	27.5%	33.1%	35.3%
Cyprus	12.1%	13.4%	17.2%	21.0%	22.9%	26.1%
Latvia	16.5%	17.4%	18.4%	21.3%	23.5%	26.1%
Lithuania	15.2%	16.1%	17.5%	21.4%	24.4%	26.7%
Luxembourg	14.2%	14.6%	16.5%	19.8%	22.3%	22.1%
Hungary	15.6%	16.7%	20.3%	22.3%	24.8%	28.1%
Malta	13.2%	14.2%	19.4%	22.4%	22.5%	24.7%
Netherlands	14.0%	14.9%	18.8%	22.5%	24.6%	23.5%
Austria	16.0%	17.7%	20.0%	25.1%	29.3%	30.4%
Poland	13.1%	13.5%	18.2%	22.6%	24.8%	29.4%
Portugal	17.0%	17.7%	20.3%	24.3%	28.5%	31.9%
Romania	14.7%	14.8%	17.1%	19.8%	24.9%	29.6%
Slovenia	15.3%	16.5%	20.4%	25.1%	28.4%	31.1%
Slovakia	11.6%	12.3%	16.3%	20.8%	24.1%	29.3%
Finland	15.8%	16.9%	22.6%	26.1%	26.7%	27.0%
Sweden	17.2%	18.3%	21.2%	23.1%	24.6%	24.3%
United Kingdom	16.1%	16.6%	19.5%	22.9%	25.9%	26.6%

Figure 8: Predicted percentage of older people (≥ 65 years) in the EU-27 Member States by 2050 (Eurostat, 2008)

The share of older people will increase to at least one-quarter in almost all EU Member States by 2050. It will be well over 30 percent in countries that are already coping with unfavorable traffic crash figures. Moreover, the percentage of older people will at last double in some Member States between 2000 and 2050.

	2005	2010	2020	2030	2040	2050
Belgium	4.3%	5.0%	6.0%	7.2%	9.6%	11.3%
Bulgaria	3.1%	3.8%	4.8%	6.6%	8.7%	10.0%
Czech Republic	3.0%	3.5%	4.0%	6.5%	8.1%	8.7%
Denmark	4.1%	4.1%	4.5%	6.6%	7.4%	8.7%
Germany	4.3%	5.0%	7.1%	8.0%	10.3%	13.6%
Estonia	3.1%	3.9%	5.0%	5.5%	7.2%	8.0%
Ireland	2.7%	2.8%	3.3%	4.7%	6.3%	8.1%
Greece	3.4%	4.4%	6.0%	6.6%	8.3%	10.4%
Spain	4.3%	5.0%	6.0%	7.3%	9.5%	12.8%
France	4.5%	5.3%	6.2%	7.7%	10.1%	11.3%
Italy	5.0%	5.8%	7.4%	8.8%	10.5%	14.1%
Cyprus	2.7%	2.9%	3.8%	5.4%	7.2%	8.2%
Latvia	3.0%	3.9%	5.2%	5.6%	7.2%	8.3%
Lithuania	3.0%	3.8%	5.0%	5.5%	7.2%	9.2%
Luxembourg	3.2%	3.9%	4.4%	5.1%	6.7%	8.4%
Hungary	3.3%	3.9%	4.7%	6.2%	8.3%	8.5%
Malta	2.8%	3.2%	4.1%	6.3%	7.9%	7.5%
Netherlands	3.5%	3.7%	4.1%	5.8%	7.0%	8.3%
Austria	4.2%	4.8%	5.5%	7.3%	9.2%	12.6%
Poland	2.5%	3.2%	4.2%	5.4%	8.8%	8.8%
Portugal	3.8%	4.4%	5.6%	6.8%	8.6%	10.7%
Romania	2.4%	3.0%	4.0%	4.6%	6.8%	8.4%
Slovenia	3.0%	3.8%	5.1%	6.3%	9.1%	10.6%
Slovakia	2.4%	2.7%	3.1%	4.4%	7.1%	8.0%
Finland	3.8%	4.5%	5.4%	8.0%	9.9%	10.3%
Sweden	5.3%	5.3%	5.3%	7.6%	8.1%	8.9%
United Kingdom	4.4%	4.6%	5.1%	6.8%	8.1%	10.2%
EU-27	4.0%	4.6%	5.7%	7.1%	9.1%	11.2%

Figure 9: Predicted percentage of older elderly (≥ 80 years) in the Member States of the EU-27 by 2050 (Eurostat, 2008)

The increase during the period under consideration will be smallest in Sweden, Luxembourg, Estonia, Latvia, and Belgium, while the greatest increase is expected in Slovakia, Ireland, Poland, the Czech Republic, and Cyprus. It is thought that Spain, Italy, Bulgaria, Greece, and Portugal will have the highest percentage of older people in their populations by 2050. The percentage of people aged 80 and over will increase even more during the period under consideration (see Figure 9), which is particularly important where traffic safety is concerned, because the older elderly are more likely to be involved in a traffic accident than the younger elderly.

The percentage of people over 80 is projected at least to double by 2050 in almost all Member States and in some cases even to triple. Slovenia, Poland, Romania, Slovakia, and Bulgaria – also countries with certain problems in the area of traffic safety – will probably experience the greatest growth between 2005 and 2050, while the increase will probably be least in Sweden, Denmark, Great Britain, the Netherlands, and France. It is expected that Italy, Germany, Spain, Austria, and France will have the highest percentage of people over age 80 in their respective populations.

Demographic changes and traffic safety

At the present time, every fifth person who dies on the road in the EU-27 is aged 65 or older (see Chapter 3). As a result of demographic changes, far more elderly people will use the road than was previously the case, which means that the traffic safety situation will also change with regard to the involvement of older people. The European Traffic Safety Council (ETSC) recently forecast the effects of demographic changes on the future traffic safety situation in Europe (ETSC, 2008a, ETSC 2008b). Assuming that the mortality rates[3] for both the elderly age group and the age groups of the remaining population remain constant (or change in the same way in both groups), it is possible to estimate the effect of the changing percentage of older people in the population on future traffic mortality figures[4]. Accordingly, it must be assumed that approximately every third road traffic fatality in the EU in 2050 will be a person age 65 or older (see Figure 10).

[3] Traffic fatalities per 100,000 population

[4] A detailed discussion of the analysis is contained in the *Methodological Notes* of the ETSC study (ETSC, 2008b) and Eksler (2007), Road Mortality in Europe: How sensitive is it to demographic structure and population dynamics? *IATSS Research, 31*(1), 80-88

The influence of the changing percentage of elderly people in the population on future road mortality varies between individual countries, because the mortality rates for the group of older people and the group of the remaining population differ considerably among this various countries (see Chapter 3).

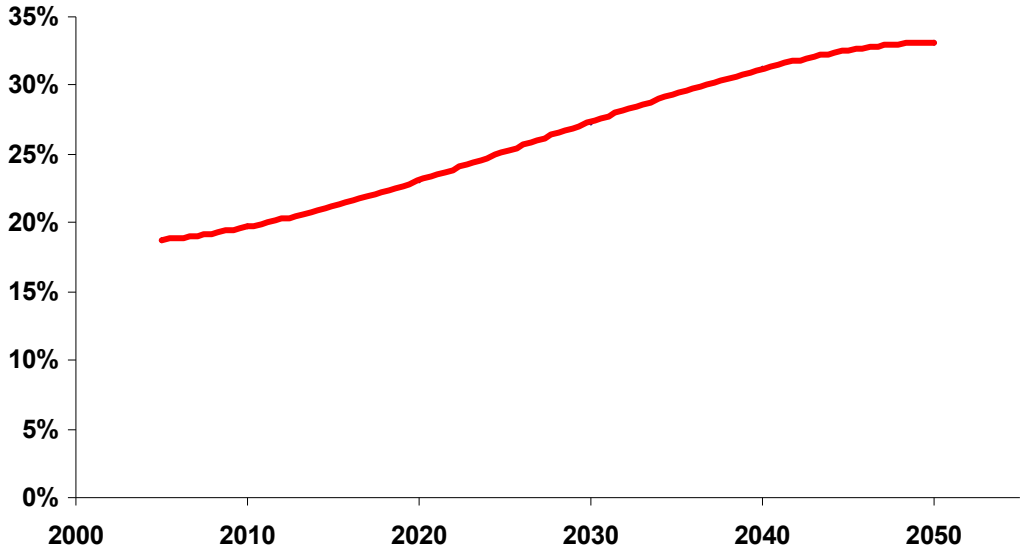


Figure 10: Projected traffic fatalities among the elderly (≥ 65 years) as a percentage of all traffic fatalities in the EU-27 through 2050 (Eksler, 2007 and ETSC, 2008b)

Figure 11 shows that the aging of the population through 2020, most likely in 21 of the 27 EU Member States, will contribute to an increase in traffic mortality compared with the numbers to be expected based on the current age distribution in the population. In these countries, it is likely that the increase in the percentage of older people, as well as the relatively high mortality rate for older people (compared with the remaining population in the country concerned) will have a negative effect on the overall road safety situation. That effect will probably be seen most clearly in the Netherlands. Due to the increasing percentage of older people and their higher mortality (compared with the remaining population), an increase of almost five percent in the number of road fatalities is projected there by 2020. The aforementioned effect will probably be over one percent in eight other countries. It is anticipated that the effect will contribute to a slight reduction in traffic mortality in six countries. The accident figures show that the safety situation is affected by aging even in countries with a fundamentally higher traffic safety standard.

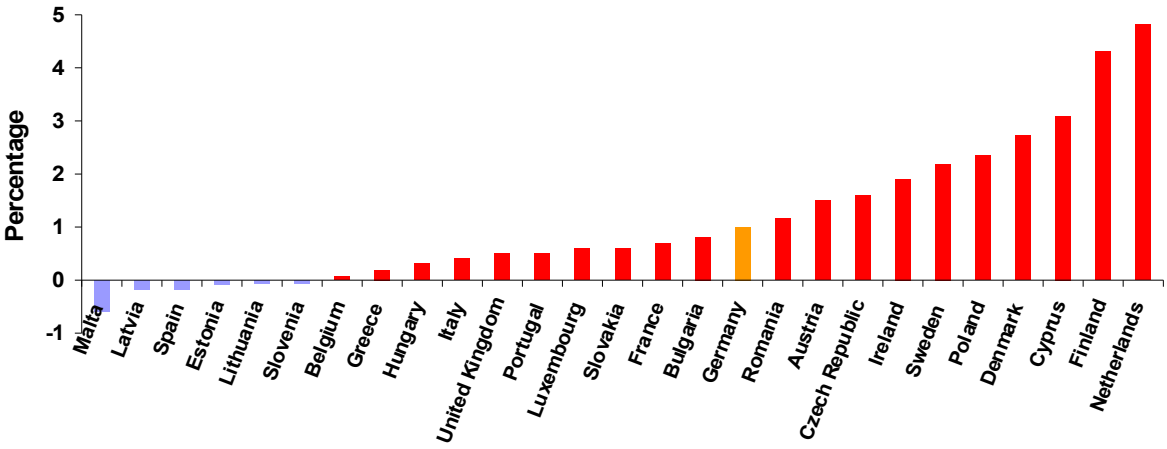


Figure 11: Effect of the aging of the population on traffic fatalities in 2020 in the Member States of the EU-27 – percentage increases (ETSC, 2008b)

Demographic changes in Germany

The age distribution for the group of people over 64 in Germany is approximately 20 percent, while the most important reference group (the 25-64 age group) totals about 55 percent (Figure 12). The growth forecast was previously discussed, now the graphic given below (Figure 13) shows that the age reference curves, who count for the expectations here, have been changing since years or, more precisely, have been coming closer together.

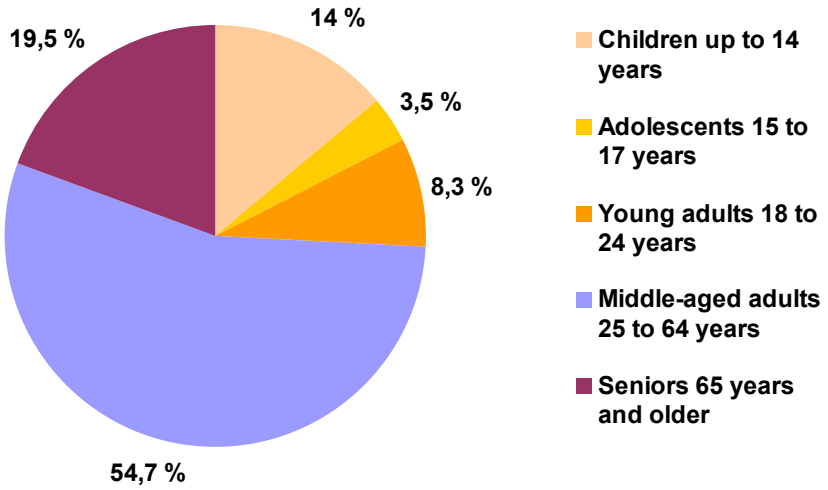


Figure 12: Percentage age class distribution in Germany, 2006, annual average of inhabitants (StBA, 2007)

In addition to the national trend in Germany, the situation in the German states and areas is also of interest. This report can provide only a brief overview of the crash statistics for older people in the German states (section 4.1.5). However, it should be noted that the progressive aging of the population is taking place in rural areas, which is where characteristic problems of road safety occur.

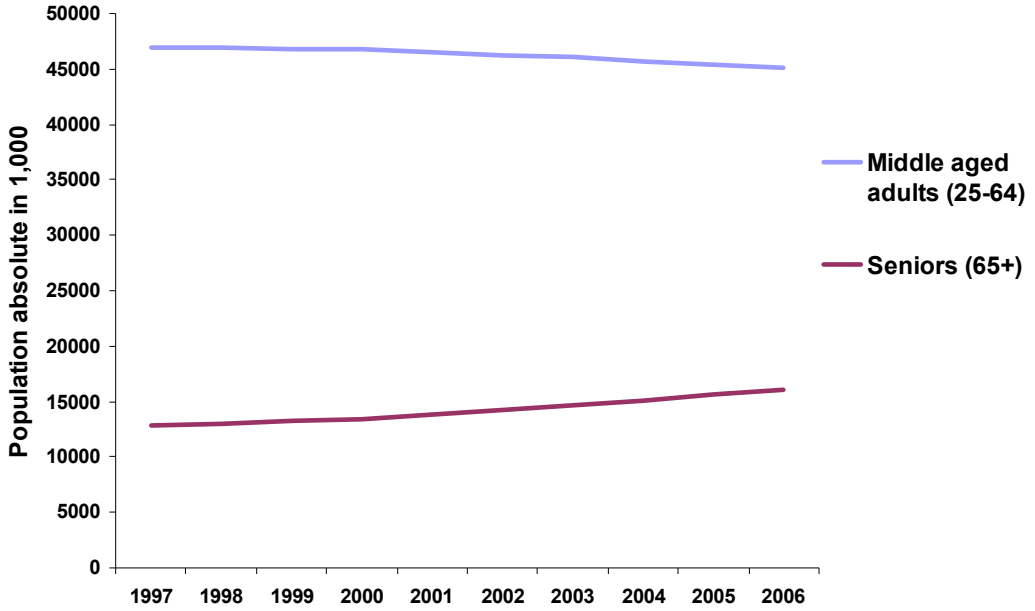
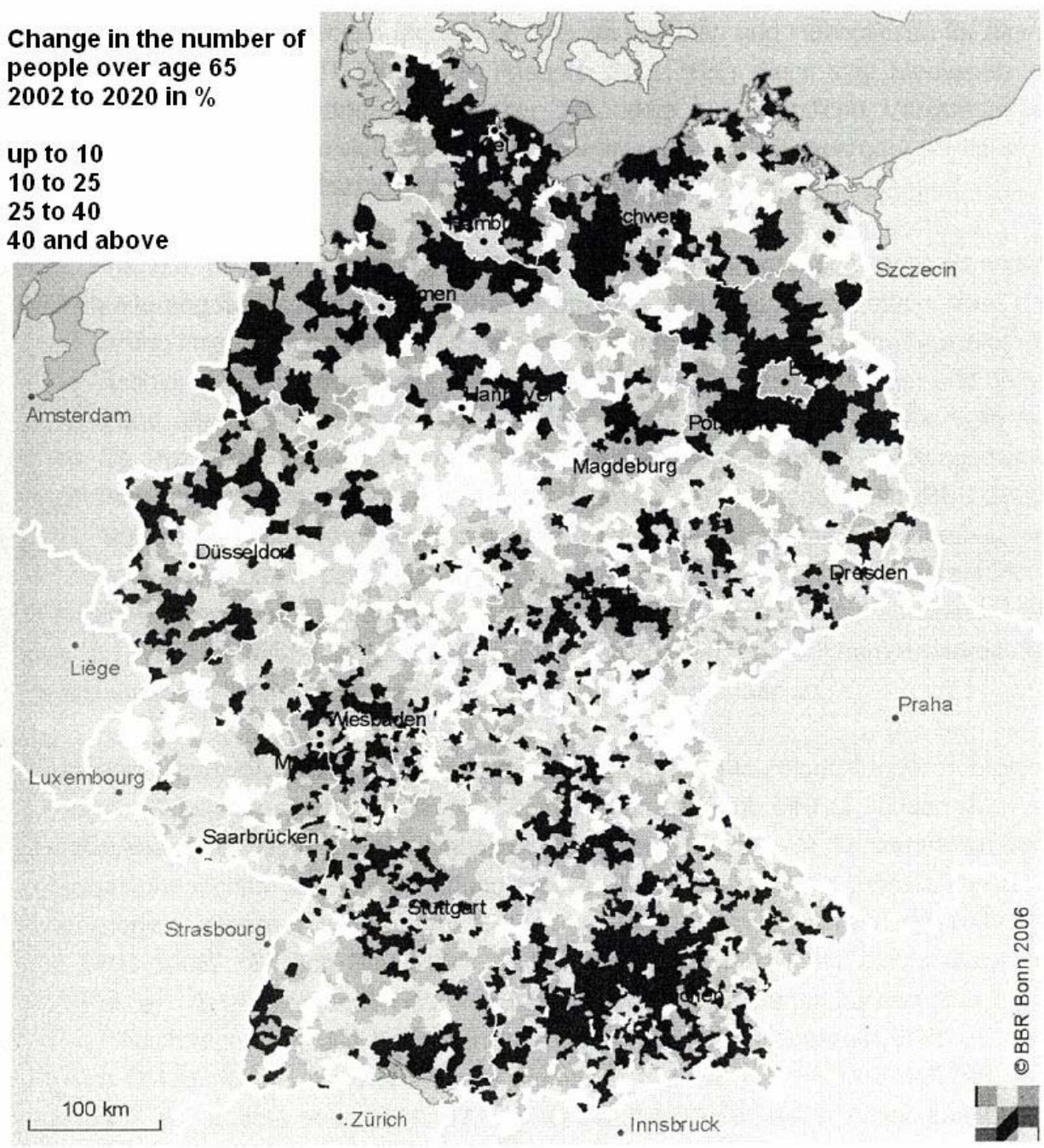


Figure 13: Trend for the age class distribution of older people and the 25-to-64 age group in Germany (Database: StBA, 2007)

The graphic below (Figure 14) shows the percentage increases in the elderly population by region. It documents what experts refer to as the aging of "suburban areas". The areas shown in black do not indicate the current distribution of the elderly (according to primary place of residence) but rather the predicted percentage change through 2020. A comparison with the graphics in section 4.1.5 will confirm the importance of the increase in the elderly population, particularly in the German states of Bavaria, Schleswig-Holstein, Thuringia, and Mecklenburg-Western Pomerania, as well as Baden-Württemberg and Lower Saxony. These are the states with the highest mortality rates among the elderly in 2006, led by Thuringia and Bavaria. The crash rates are strikingly similar to the projected distribution.

It has already been shown that work will have to be done to improve the safety of road users in those rural and suburban areas due to current shortcomings that affect the mobility of older people. The Free State of Bavaria – also a leader in the accident fatality statistics for

other age groups – and northern Germany and the countryside surrounding Berlin will face challenges that cannot be met simply by funding public transport – transport that will have to tackle structural problems in any case (see Chapter 3). Experts unanimously agree that the safety of older people will also require an increased focus on the pattern of accidents on rural roads.



Source: Slightly modified according to Schlömer and Bucher (2006: 212)

Figure 14: Percentage change in the number of older people by residence between 2002 and 2020 in Germany (BBR, 2006, image cited according to Rauprich, 2006, English by the authors)

3 Mobility patterns, requirements, and needs

Mobility is a fundamental prerequisite for being able to continue to lead an independent life as we age (Deubel, et al., 1999; Engeln & Schlag, 2001, and many others). It is necessary for many activities of daily life. Mobility makes social activities and participation in society possible and plays an important role in both the individual and societal spheres. Research on aging indicates that well-being and longevity are associated with retaining mobility and having the freedom to structure one's own mobility. In future, in addition to the demographic factors that have been described, other factors such as increased health and improved access to material resources will influence the mobility behavior of succeeding cohorts (BASt, 2007).

Generally speaking, the role of mobility (which includes driving or riding in a car, use of public transport, bicycle riding, and walking) will be increasingly important for older people (Kocherscheid & Rudinger, 2005), although this is not specifically reflected yet in increased mileage traveled by car (see below). However, there has hardly been any reference data on old age showing the details for various parts of Germany. Updates of mobility surveys by the German federal government, on behavior of road users, *Continuierliche Erhebung zum Verkehrsverhalten* (KONTIV, 1976, 1982, 1989), and on mobility, *Mobilität in Deutschland* (MiD, 2002 and currently in progress since 2008), provide only limited assistance in this context. Other surveys are often specific to certain regions.

The available studies do show that not only do older people get around on public transport, as car passengers, or on foot, but they also continue to drive even at advanced ages (Mäder, 2001; Rudinger, Holz-Rau & Grotz, ed., 2006 among others). Being licensed to drive and owning and having access to a vehicle are considered to be major factors in determining the choice of a transport mode (OECD, 2001). Along with mileage figures and population numbers, they are also potential reference variables for determining crash and/or casualty rates.

The data provided below for Germany and Europe clearly shows considerable potential for the group of older road users, although some increases, such as the driver's licensing rate, are primarily attributable to cohort effects and it is foreseeable that these increases will level off.

Holding a driver's license and owning and having access to a car

In Europe there are obvious differences in the rate at which men and women in the various age groups hold driver's licenses. The licensing rate for the current group of older people is between 71 and 93 percent for men and between 7 and 46 percent for women, as given in Figure 15 for selected countries.

	Age group	**Men (%)**	**Women (%)**
Germany	≥ 65	80	25
Finland	65-74	79	27
United Kingdom*	65-69	82	34
Netherlands	65-74	81	42
Norway**	67-74	93	46
Spain	65-74	71	7

* 1995-1996, ** 1997-1998

Figure 15: Licensing holders in older people per percent in selected countries (OECD, 2001; BASt 2001)

Only a relatively small portion of the current group of older people in Europe are licensed. This lower percentage of driver's license holders is a cohort effect (Beckmann, et al., 2005). The licensing rate of older people will increase in the future, since most of today's "middle-aged" adults have a driver's license (Engeln & Schlag, 2001). For example, over 90% of the people in the current 30-40 age group are licensed (ibid.). Figure 16 shows the percentage of older people who are expected to hold a driver's license in 2030 (OECD, 2001).

The projected growth rates vary considerably among the countries shown. They range from a 40 percent increase in Sweden – where a relatively high percentage of older people are already licensed – to a 93 percent increase in the Netherlands, where relatively few older people had driver's licenses in 2000. The percentage of older people with a driver's license will therefore continue to increase throughout the European Union in coming years.

In Germany more than 90 percent of men born from 1929 to 1934 already have a driver's license, while that level is not reached by women until birth years from 1959 to 1964 (Beckmann, et al., 2005).

	Driver's license holders ≥65 in 2000 (%)	Driver's license holders ≥65 in 2030 (%)	Increase from 2000 to 2030 (%)
Finland	14.9	26.7	79
France	16.1	25.8	60
Netherlands	13.7	26.5	93
Norway	15.3	23.5	54
Spain	16.8	26.1	55
Sweden	17.2	24.1	40
United Kingdom	15.7	23.5	50

Figure 16: Projected licensing holders in older people per percent in selected countries (OECD, 2001)

Accordingly, it will not be until around 2030 that at least 90 percent of women in the 70-75 age group are licensed to drive. Figure 17 shows the calculations recently published by the German Federal Highway Research Institute (BASt) on licensing rates between 2003 and 2004. It clearly shows the increase in the elderly age classes and also shows the slight decline in the group of novice drivers.

Holding a license does not necessarily mean having access to a car, however. That is what defines "freedom of choice" in mobility. The difference between having a driver's license and actual "constant" access to a vehicle becomes particularly clear for women (OECD, 2001). Although car ownership by women strongly increased for all age groups in Germany from 1976 to 2002, for older cohorts it is still less than the car ownership rate for men in the corresponding age cohorts (Beckmann, et al., 2005). For example, in 2002 over 80 percent of men in the 71-75 age group had a vehicle, while the percentage for women in that group was just over 30 percent (ibid.). That difference in car ownership was also observed in Sweden. In the mid-1990's, 80 percent of men in the 65-74 age group there had access to a vehicle, while only 45 percent of women in that age cohort did (OECD, 2001). Figure 18 shows the constant (not just occasional) availability of a car in Germany and changes in it between 1998 and 2003 according to data of the research institute Deutsches Institut für Wirtschaftsforschung (DIW, 2003, 2006). Availability is improving for women, while it is declining for young men, in line with the licensing rate.

According to a study done by the Technical University of Dresden for the German Federal Highway Research Institute (Ahrens, 2007) the availability of cars – calculated in this case for urban structures – will primarily affect all older age groups through 2020.

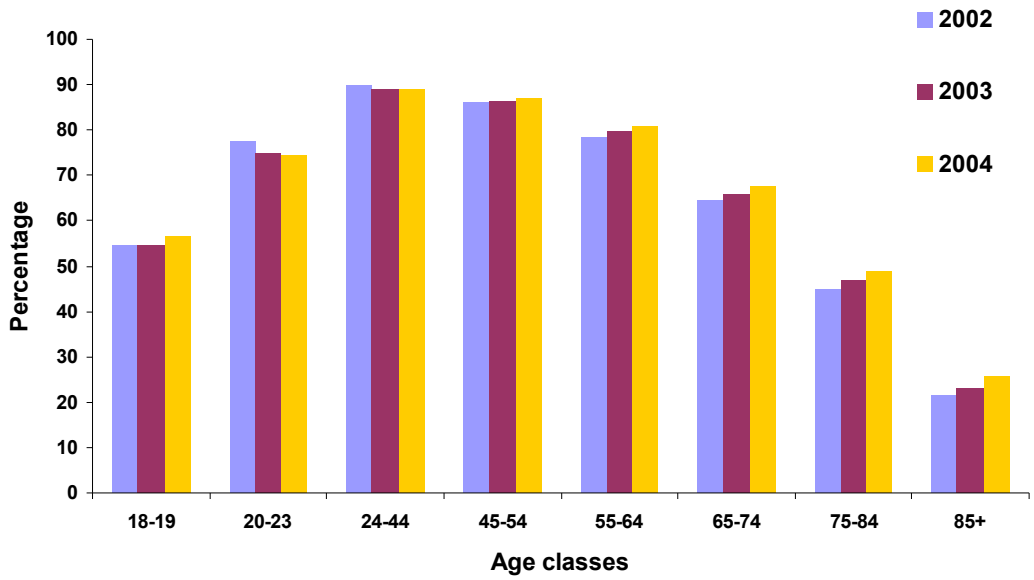


Figure 17: Licensing rate (%) for class B/BE (car) driver's license in Germany (BASt and DIW, 2007)

Finally, car ownership according to registration data for Germany: Figure 19 shows the trend according to German Federal Motor Transport Authority (KBA). Greatest increases – although recently also caused by a cohort effect – are among older people. And, again, statistics show a slight decrease in young adults who own cars, probably due to recent economical situation.

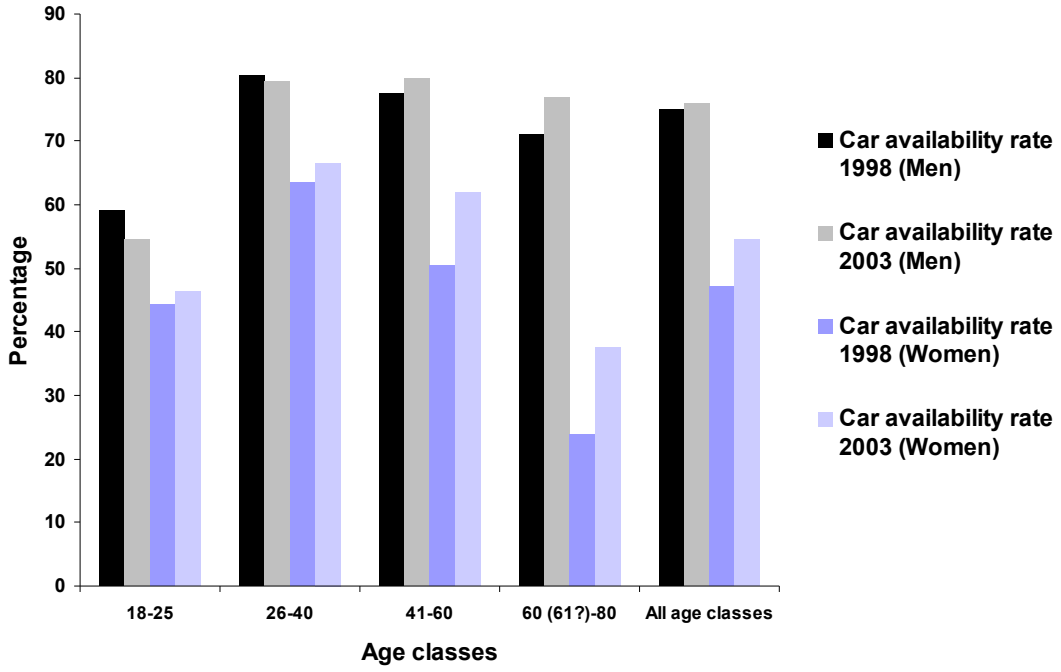


Figure 18: Availability of a car (percentage) by sex in Germany in 1998 and 2003 (DWI, 2003, 2006)

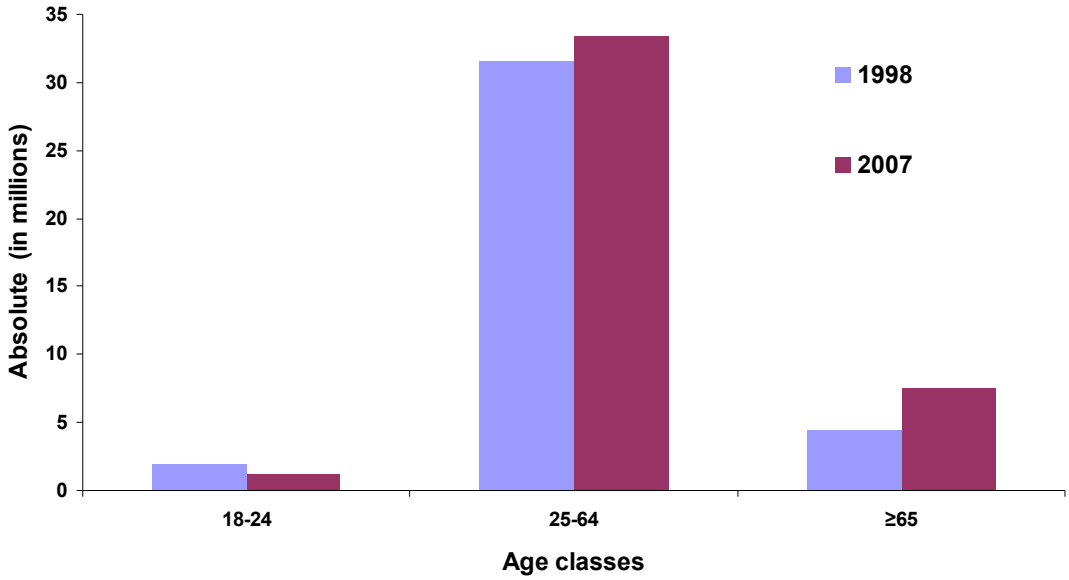


Figure 19: Figures of registered cars (in millions) by age of holder in Germany, 1998 and 2007 (according to KBA, 1999, 2008)

Number of trips and length of daily travel

On average older people in Europe take fewer trips and travel shorter distances than younger people (ERSO, 2006). Figure 20 illustrates this aspect for various countries, although comparability is limited due to different survey methods.

	Age group (elderly)	Age group (non-elderly)	Number of trips per day		Travel length per day (km)	
			Elderly	Non-elderly	Elderly	Non-elderly
Germany (1997)	75-79	18-59	1.9	3.4	8	22
UK, men (1996-1998)	75-79	25-49	2.2	3.3	15	50
UK, women (1996-1998)	75-79	25-49	1.6	3.5	12	32
Sweden (1994-1996)	75-79	40-49	1.5	3.2	12	35
Norway (1997-1998)	≥ 65	25-49	1.9	3.5	16	35

Figure 20: Number of trips and distance traveled by elderly and non-elderly people, any travel mode, for D, UK, S, & N (OECD, 2001)

In many countries, there are marked differences between the distances traveled by older men and women (OECD 2001). In Norway, for example, older men (≥ 75 years) travel an average of 25 km per day, while women in that age group travel only around 9 km on all travel modes. There are comparable differences in Germany and Sweden (ibid.). There is also a noticeable

decrease in the number of trips and the distance traveled per day by people around age 65 in Sweden and Norway. This is primarily due to the transition from active employment to retirement at that age (ibid.). The number of trips for other activities (shopping, maintaining social contacts, and other leisure activities) remains nearly constant starting at age 75. An obvious change in the activity structure in favor of shopping and leisure activities can be observed during the transition to retirement in Germany, as well (Beckmann, et al., 2005). In addition, the distances traveled in all weekday trips have tended to increase for the older age groups since the 1970's. Those greater distances over time are increasingly traveled by private car, while distances traveled using non-motorized modes or public transport have decreased (ibid.).

Car mileage

In terms of the car-based mobility of older drivers in Germany, various studies have observed that the average mileage traveled annually decrease with the age of the primary car user (BASt, 1996; Mäder, 2001, Hautzinger, et al., 2005). An analysis by the German Federal Highway Research Institute back in 1990 showed that the car mileage by main users over age 75 are about three times shorter than those of main users in the 35-44 age group (Hautzinger, et al., 1996).

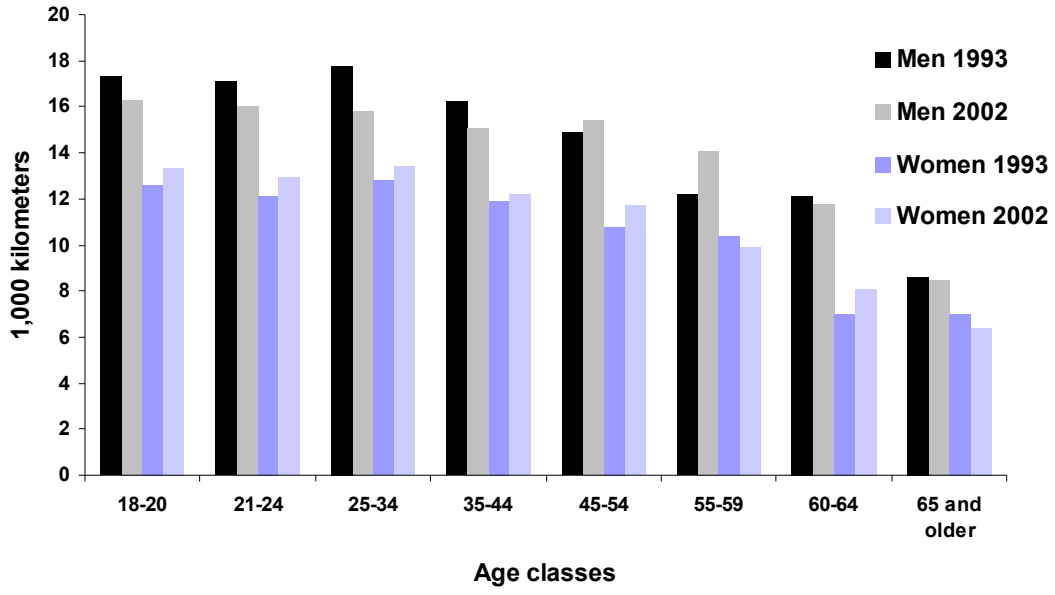


Figure 21: Average annually private passenger car mileage by age and sex of the main car user in Germany, 1993 and 2002 (BASt/Hautzinger, et al., 1996 and 2005)

The decline in annual mileage is less for truck drivers. If a truck driver over age 64 is still professionally employed, or forced to drive a truck for any reason, he is less able to compensate through deliberate limitations for the individual stress on him as a result of his driving activity (Fastenmeier, Gstalter & Kubitzki, 2007). Figure 21 summarizes the data on average annual car mileage traveled in 1993 (published in 1996) and 2002 (published in 2005) in Germany. As was the case for the licensing rate and car availability, again a decline in motorized individual mobility in young men will be seen.

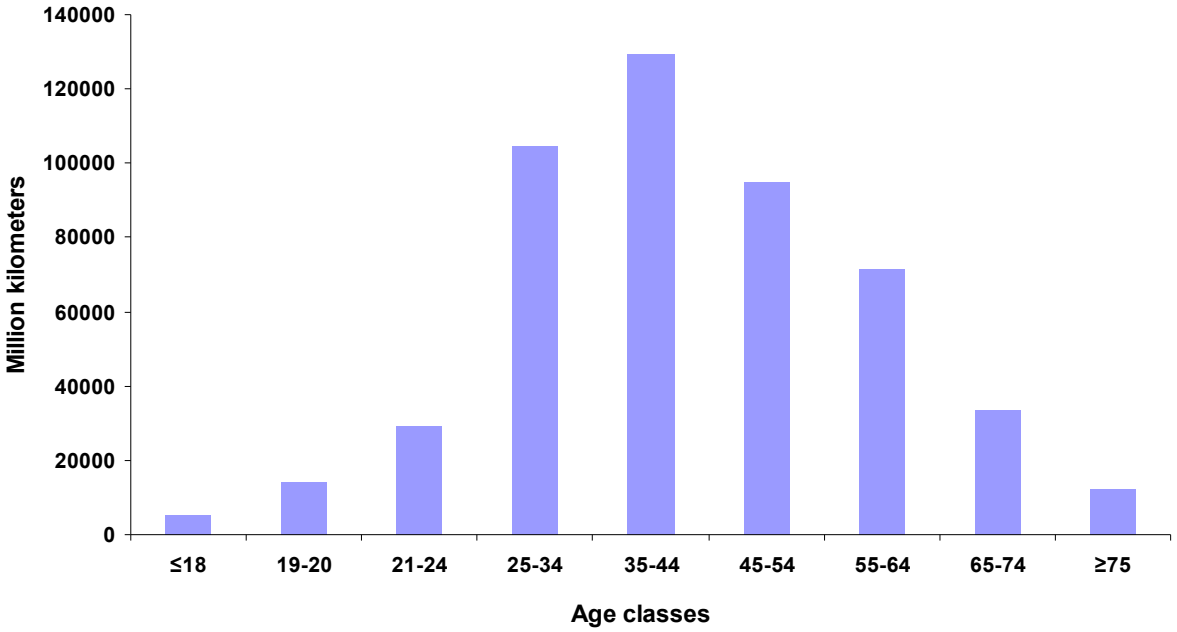


Figure 22: Absolute sums of mileage (in million kilometers) traveled annually by drivers of private passenger cars in Germany, by age class, 2002 (BASt/Hautzinger, et al., 1996 and 2005)

Figure 22 shows the annual total sums of private car mileage (in kilometers) by each age group in 2002 for Germany (Hautzinger, et al., 2005). Sums are lower for people in the 18-24 year age group compared with the mean mileages because the total group is only slightly over 8 percent of the population. The graphic clearly shows that the group of older people (≥ 65) accounts for only 9-10 percent of Germany's annual mileage traveled by private car. The rate is 2.5 percent for the group of people over age 75. Correcting crash figures for car mileage therefore initially results in rates that increase with age (compared with the field of middle-aged adults). But considering the group as a whole leads to a distortion: Drivers who travel long distances each year necessarily have a lower crash risk per kilometer than drivers who travel shorter distances in terms of mileage. The crash risk of older drivers which is so often mentioned is therefore attributable to their potentially smaller mileages (Janke, 1991).

Various studies have shown that the accident risk of older drivers with higher mileage per year is comparable to that of younger age groups with the same mileage (Hakamies-Blomqvist, et al., 2002; Langford, et al., 2006). Both older and younger car drivers, who annually perform at least fewer mileage, have more accidents per kilometer driven than do drivers in both age groups who travel more. According to Langford, et al. (2006), the crash involvement of older drivers increases only for drivers who drive less than 3,000 km per year, and that increase is not observed until age 75.

Mobility preferences

Even if the average mileages by older people each year do not increase markedly, they tend to use the road by driving a car rather than using other transport modes (BASt, 2007, and many others). This is related to the increased importance that society attributes to individual mobility. Mobility and the ability to get around are among the most important prerequisites for the satisfaction of older people and ensure quality of life (ibid., Mollenkopf, 2002). Engeln and Schlag (2001) investigated the interconnection between mobility and healthy aging in the "ANBINDUNG" research project. Several empirical studies of mobility behavior were done in 1996, 1997, and 1998. According to Engeln and Schlag, the choice of a transport mode by older drivers primarily depends on the availability of a car. If so, approximately two-thirds (64.7 %) of all trips were by car then (see Figure 23). Walking still accounts for almost one-quarter (24 %) of all trips. Bicycles were the mode of choice for 8 percent of all trips. At 2.1 percent of all trips, public transport accounts for a very small portion of everyday mobility.

Cars also maintained their dominant position in five out of six categories[5] in relation to the location of mobility destinations. Older drivers use the car even for destinations within the same town in over 50 percent of cases. Cars are less important only for destinations in natural areas or the countryside, where pedestrian traffic dominates. Engeln and Schlag (2002) have noted that older drivers use their cars frequently but that they do so less because they enjoying driving and more because they see no acceptable alternatives to maintaining their mobility. Many older people feel dependent on their cars and perceive several burdens due to driving, which indicates a willingness to switch to more attractive alternatives (Engeln & Schlag, 2002). However, the existing alternatives are often associated with even more pro-

[5] Categories: Same town, neighboring town, middle order center, high order center, distant destination, natural area/countryside

blems from the viewpoint of older drivers. This relates particularly to public transport. Avoidance of public transport has been found in other studies, as well (AMEÏS, 2001, and many others). Experts all over Europe agree (SIZE, 2006) that this is due to a series of factors, both objective (such as failure of the available services to meet one's own needs) and subjective (such as fear of mugging during late evening hours). Transport experts also agree that public transport will play an increasingly smaller role. This will increase the dependency of older groups on cars (according to Rauprich, 2006). Overall quality of life does not depend on the availability of a specific transport mode, however, but rather on the freedom to choose among alternatives. For example, in spite of having a driver's license and an available car and being competent to drive, older drivers are more likely than younger people to leave the car parked due to illness or taking medications, making them more dependent on usable alternatives.

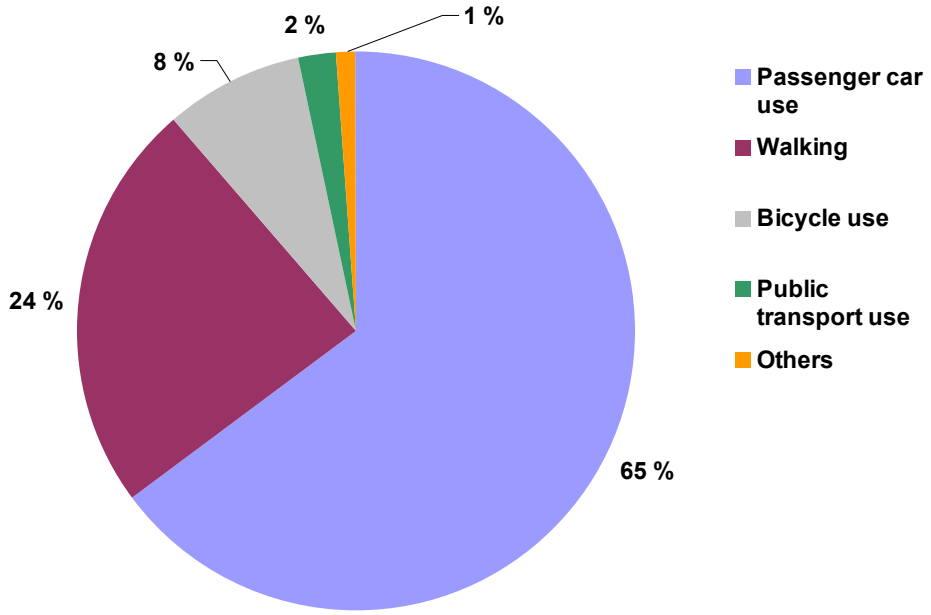


Figure 23: Choice of transport mode by older car drivers in Germany according to mobility diaries (Engeln & Schlag, 2001)

The mobility survey by the German federal government (MiD, 2002) included the transport modes used by all age and user groups. Figure 24 shows that Germans primary travel by private vehicle (usually a car), and this includes older people (in this case ≥ 60). But they are almost as intensive in walking. Again it becomes clear that public transport is playing a subsidiary role. These conclusions are supported by numerous mobility studies, according to which the car is preferred over public transport, even when riding only as a car passenger. Section 4.1 will show that this preference has a tragic effect on the casualty rates for older people.

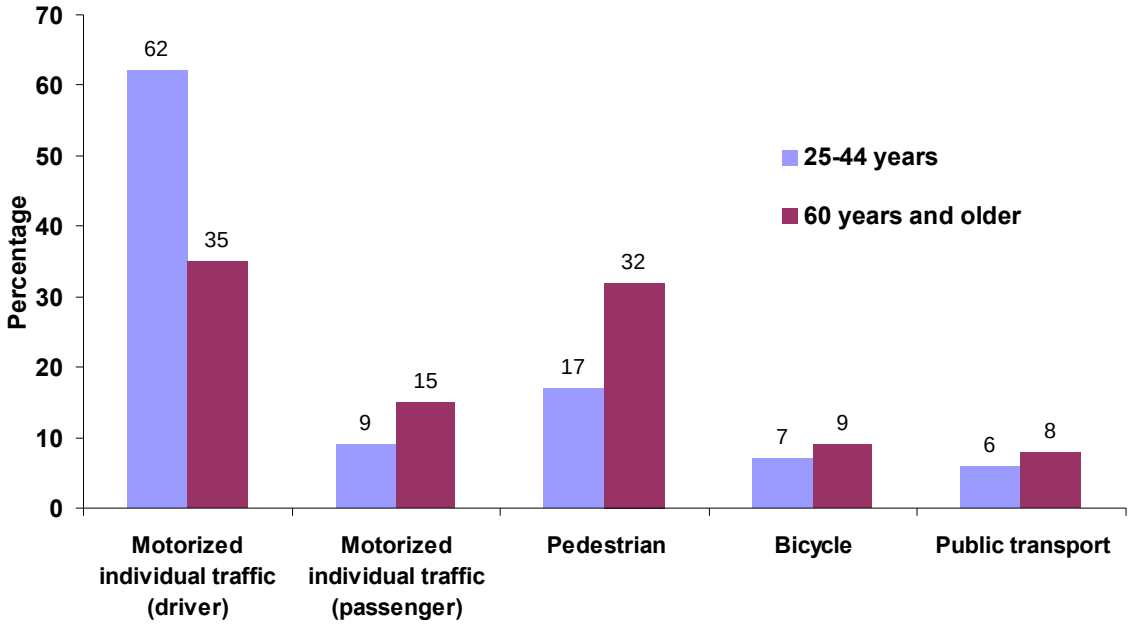


Figure 24: Trips by main transport mode in Germany (MiD, 2002)

Disabled persons and mobility

When considering crash or casualty rates, the reference variables for older people are often criticized with the argument that they are not comparable with young age groups. This applies particularly to population data: There is a greater likelihood that older people are disabled, require care, or are in the hospital. Approximately 23 percent of all older people in Germany are currently disabled (degree of disability 50-100), compared with only 5 percent of the remaining population. But there is little usable data on the type and extent of road use by these groups. The MiD for 2002 does show that the group of disabled people and even the subgroup of people with limited mobility (all age groups) travel non-negligible distances, including by car (see Figure 25). So the argument cannot be accepted as it stands. Moreover, only about 11 percent of older people are under the care of another person and only about 4 percent of older people live in nursing homes (official statistics on care and disability/ microconsensus).

But again this data say nothing about their participation in the transport system, for example when accompanied by other people. Any solution to increase the quality of transport must also include these groups.

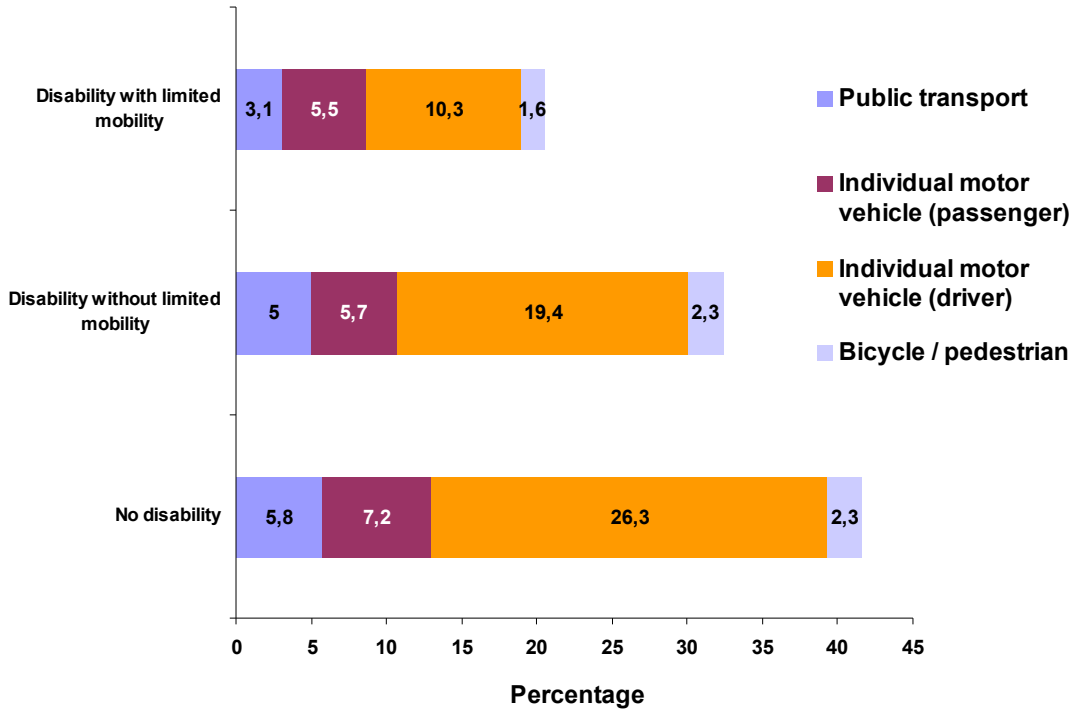


Figure 25: Per capita kilometers traveled person during the day by transport mode and type of disability in Germany, not broken down by age (MiD, 2002)

Summary: Demographics and mobility

Older people participate actively in mobility, including as car drivers. For them – and for disabled groups – the car is the transport mode of choice. Increases in licensing rates, in the availability of a car, in car ownership, and in the average annual car mileages by women have been particularly marked for older people, while those reference values actually tend to decline in young males, most likely due to economic factors. The increased senior licensing rate can be explained by a cohort effect, but the other mobility data cannot, at least not without additional information. Even if transport experts are not making reliable projections of the changing mobility behavior of the age groups, it should be noted that the increasing percentage of older people alone will lead to a shift in the percentages of all types of road users, in the percentages of people involved in road traffic crashes – and in the percentages of all casualties and fatalities among road users.

4 The safety of older road users

4.1 Accidents in Germany

Traffic on Germany's roads has become safer – including for older people – just as it has in Europe. All of the key data on casualties has been trending downward for many years. That trend is also continuing. But as shown by the introductory graphic (Figure 1), the issue of relative improvements remains. An analysis of the safety situation for Germany clearly shows that the focus of efforts in past years has been on improving the situation for the group of young and novice drivers. That was certainly right. But the data also shows that this was to the detriment not just of the elderly but also all adult age groups of road users. And that is not based solely on the number of victims. The trend in percentages of people who are primarily at fault in crashes with bodily injury also prove to be better for groups of younger road users than for older groups (not just elderly people over age 65), as will be shown below (see Figure 40). Casualty rates are down more for young people than for older people. But the percentages of people who are primarily at fault in crashes naturally can only shift. Those percentages should therefore not be neglected as an indicator for the question of what groups successfully use the road and what factors characterize them. However, there is a scarcity of more in-depth analyses of the data on various groups of people who are primarily at fault in crashes. This study therefore asked the German Statistical Office [*Statistisches Bundesamt*] to do a special analysis of selected questions. Another requirement when considering the safety of older people is an ongoing comparison with a reference group. As stated above, the group known as "middle-aged adults" (25-64 years) is usually chosen for this for reasons related to sociodemographics, traffic psychology, and crash statistics. The line between behavior and perceptions that are "typical of young people" (not just road users) on the one hand and those of "adults" on the other hand must clearly be drawn between ages 24 and 25. The safety of older people as it is understood in this report must be measured in comparison with other adult groups. Unfortunately, this is often not done in technical discussions. Time series curves are useful, not because they relate to an index based on 100, but instead because they compare different curves. This report will, after showing the general

crash situation for older people, present the most important crash and casualty figures and associated risk rates for the main types of road use.

According to the international definition of accident research, the crash, casualty, and injury risks for road users correspond to the crash rates for each reference variable (Hautzinger, Stock & Schmidt, 2005). More extensive statistical analyses are generally possible only by using non-representative samples from individual studies, such as odd-ratio calculations, considerations of the probability of the occurrence of defined events or features within defined groups, to which the conclusions are then limited. The most common reference variables are total annual mileage (mostly on motorized vehicles) and the annual mean population (year's mean), as well as, for goods transport, the amount of goods transported. This report will also present rates related to the number of driver's licenses issued and the number of registered cars (see Annex 2).

As discussed in Chapter 2, it is not an easy matter to determine from the group of all older people the group of those who are actually active road users. Disabled people are also mobile, including by car, and on the other hand the data indicates that the question about the percentage of active road users must also be asked for younger age groups. For example, the group of young men with very weak social status shows restrictions on participation in car traffic. One-sided corrections to the reference variables for older people which are based on defective underlying data are not considered appropriate in that respect.

4.1.1 The general crash situation for all types of road use

Fatalities and casualties

Older road users in Germany die disproportionately to their share of the population (Figure 26). The data barely changed between 2006 and 2007. The unrounded percentage of fatalities among the elderly increased by 0.5 percent from 22.7 to 23.2 percent, so it hardly changed based on the population. The picture is rosier for the safety of older people based on all casualties, including both major and minor injuries (with the latter being the highest percentage of all casualty). Based on all types of road use, only 10 percent of all casualties bother older people (2006) (no graphic). This discrepancy between casualties and fatalities reflects the aforementioned vulnerability of older people – the increased likelihood of dying when the circumstances of a crash are the same. Figure 27 (p. 47) shows the mortality rate

per 100,000 population (all types of road use); older people are divided into three groups. This clearly shows the increase in the probability of dying as age increases. If a distinction is also made according to all age groups (Figure 28, p. 48, shows the mortality rates per 100,000 population in 2007), it will be seen that the oldest elderly are the primary victims. This strikingly shows how the popular image of "active best-agers" distorts the facts and involves the peril of having the focus of safety efforts become one-sided. The one-year levels show that the oldest elderly (ages 80-100) represent the largest "group of victims." Finally, men tend to die on the road more frequently than women (Figure 29, p. 47). The data from MiD 2002 show that men travel longer distances and spend more time traveling, not only in cars but also when using the road in other ways, such as riding a bicycle.

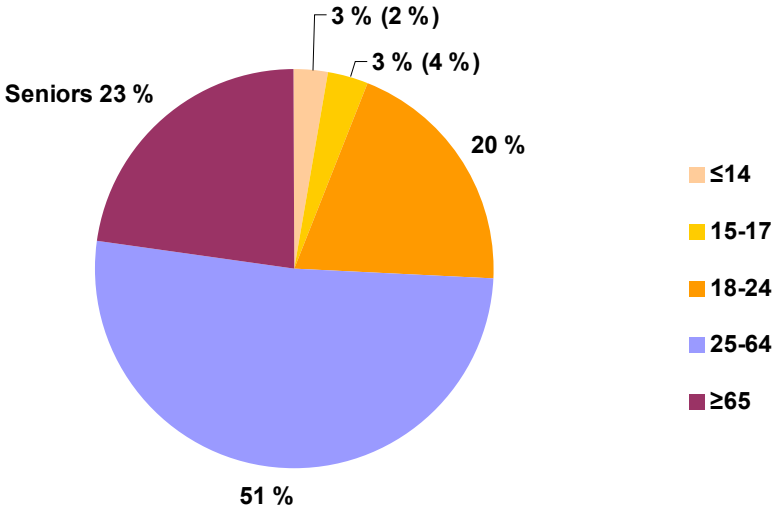


Figure 26: Road user fatalities (all types of road use) by age, 2006 and 2007 (in parentheses) (Database: StBA, 2007 and 2008)

Fatalities by road type and light conditions

Figures 30 and 31 (p. 50) show the distribution of fatalities on Germany's roads by location (all types of road use). They indicate that older people – in contrast to road users in the 25-64 age group – are dying in both urban and rural areas. The issue of transport mode and road type will be discussed in the sections entitled *Older people and car crashes, Older people and pedestrian crashes*, and *Older people and bicycle crashes*. Most fatalities involving middle-aged people are on roads in rural areas. The data clearly shows that measures to improve the safety of older people must be oriented to a broad spectrum of road use situations.

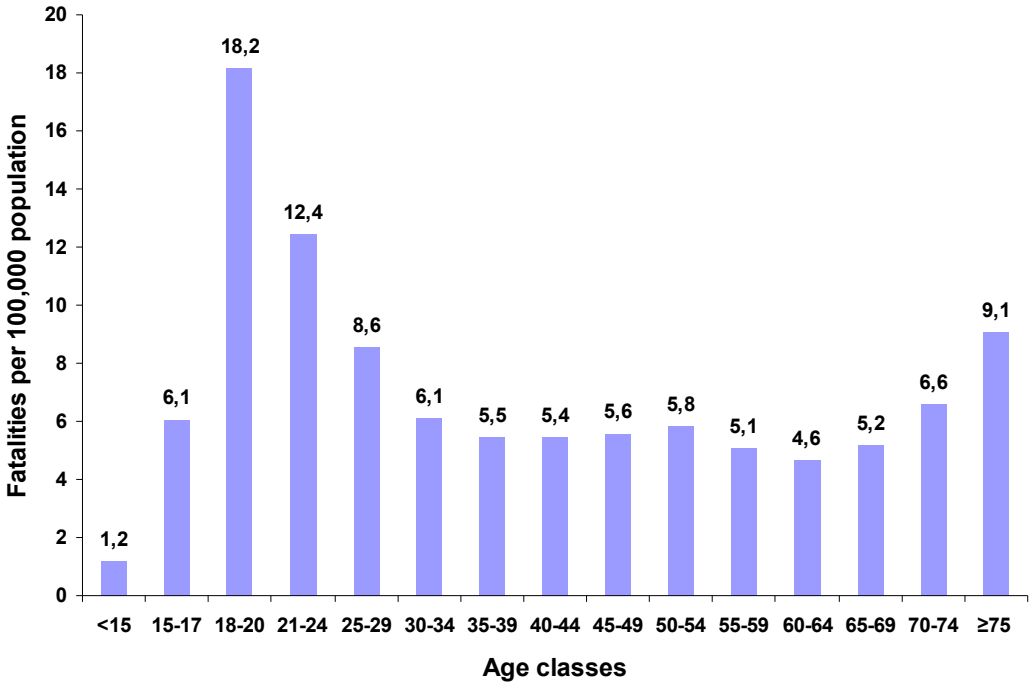


Figure 27: Fatalities per 100,000 population of the individual age class by age for all types of road use, 2006 (Database: StBA, 2007)

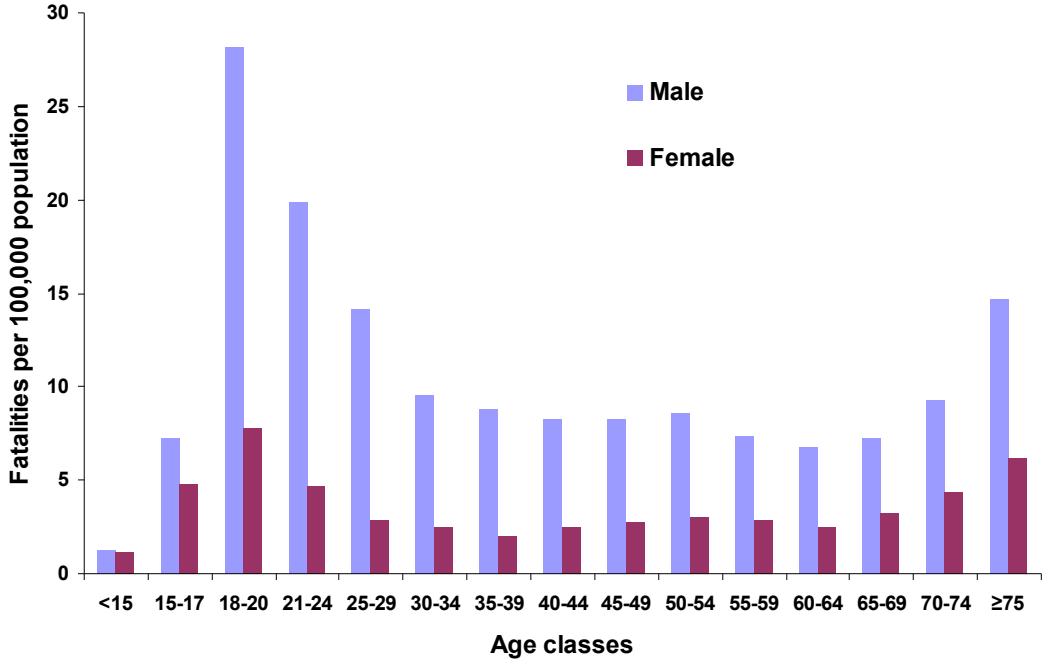


Figure 29: Fatalities per 100,000 population of the individual age class by sex and age for all types of road use, 2006 (Database: StBA, 2007)

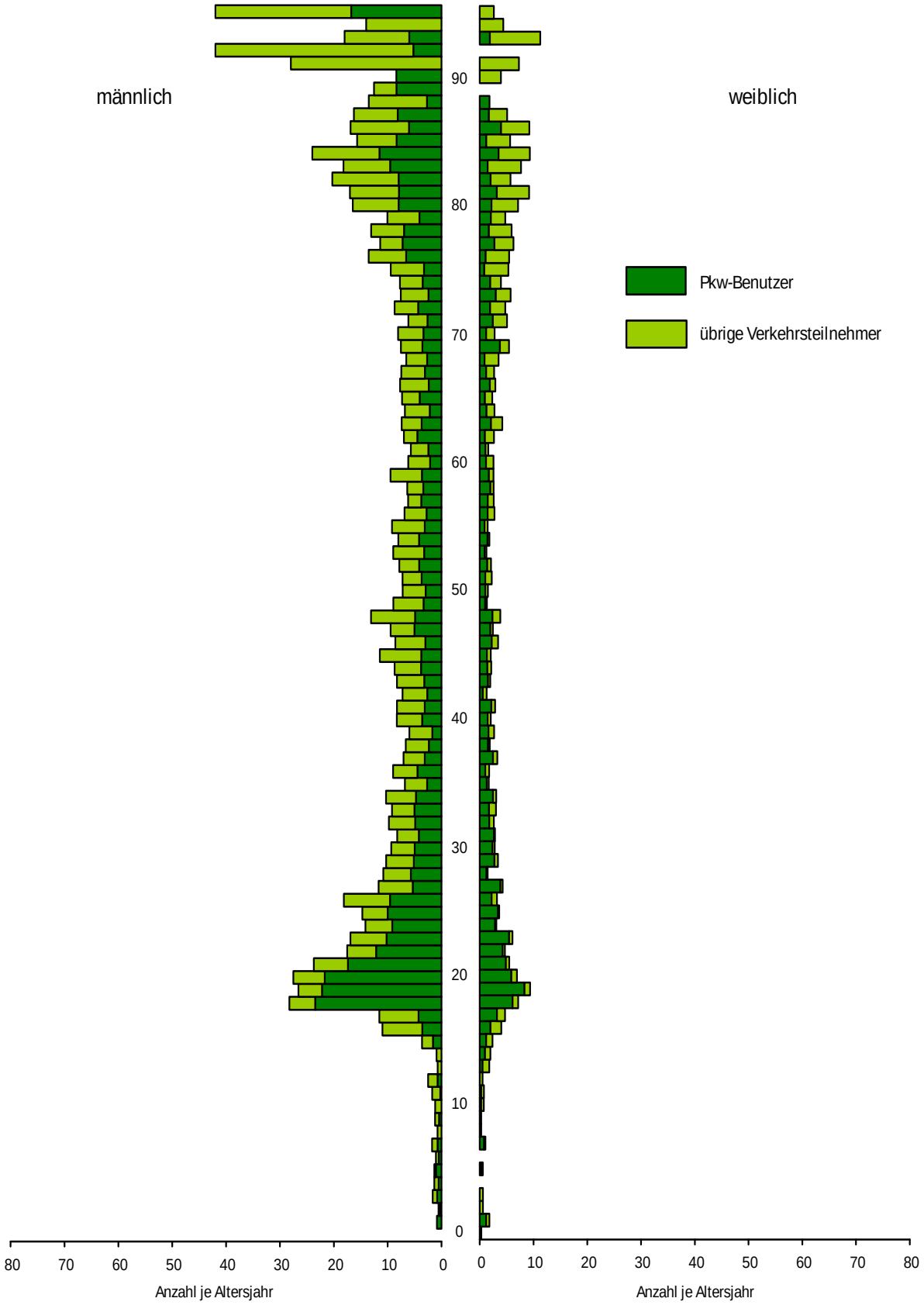
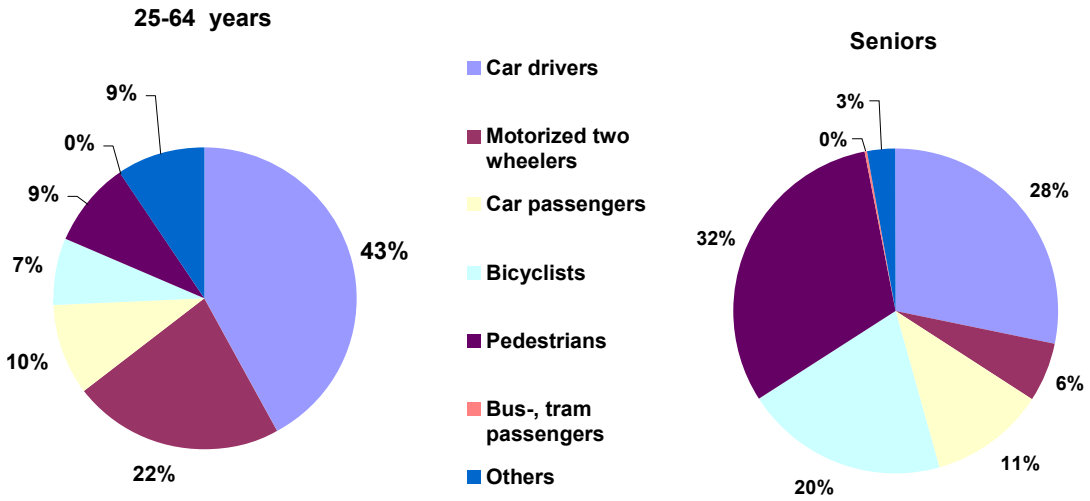


Figure 28: Fatalities per 100,000 population of the individual age class by age – all age levels – 2007 (männlich /male, weiblich/female, Pkw-Benutzer/car occupants, übrige Verkehrsteilnehmer/other road users) (StBA, 2008; image quoted with StBA)

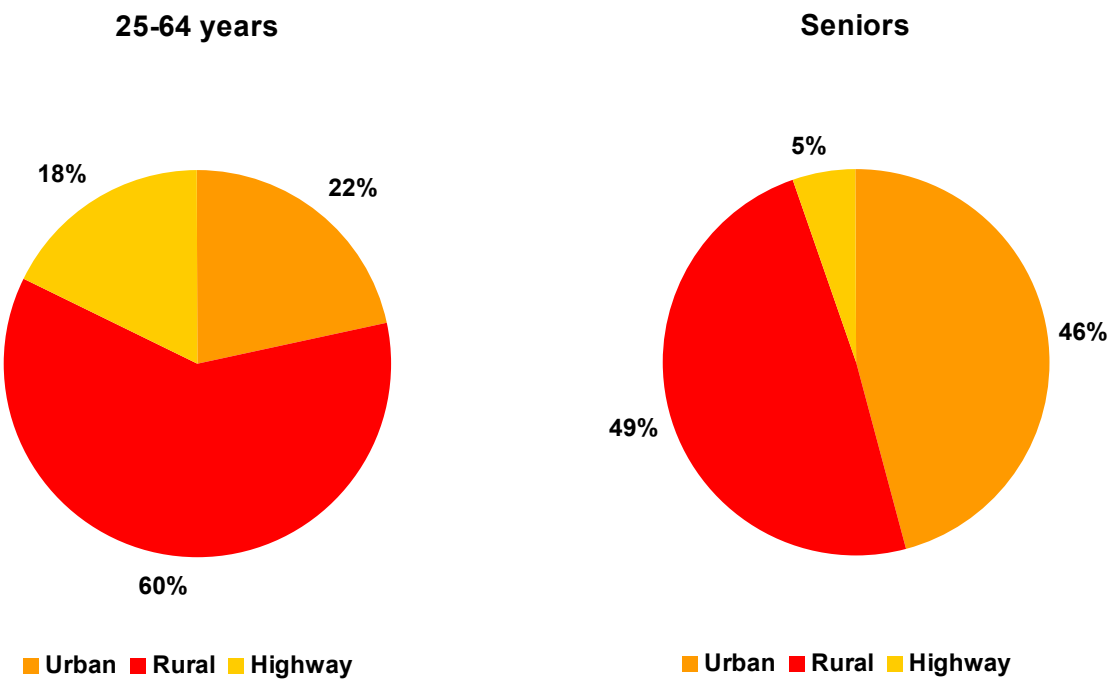
Figures 32 and 33 (p. 50) show the distribution according to light conditions (daylight, twilight, and night); for methodical reasons, the data given here are based on all car drivers involved in injury crashes for which there are police records on the type of driver error (StBA special analysis, 2008). The figures confirm that accidents involving older people primarily occur during the day. Experts consider the time of day to be a plausible reason for the behavior of the age groups concerned. According to them, seniors travel similar routes at similar times as both younger people and working people (peak time for crashes 10 a.m. to noon for older people; see StBA, 2006). At least, there are important overlaps for the mobility behavior of older and middle-aged adults, which matter in traffic safety. Finally, Chapter 5 will discuss the day-night distribution for older car drivers (including the avoidance behavior of senior car drivers); see also chapter 5 for crashes by weather and road conditions.

Fatalities by means of transport

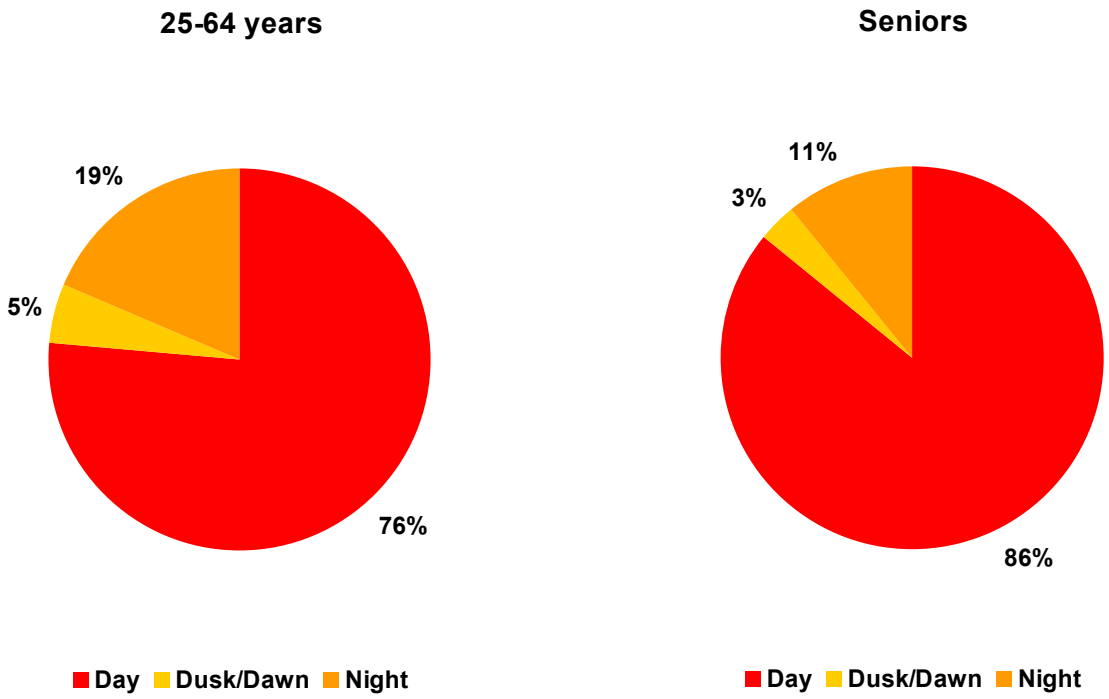
Finally, the distribution of fatalities over all types of road use according to the most important transport modes for older people: Figures 34 and 35 show that large percentages of older people die as car drivers, pedestrians, and bicyclists, while adults in the 25-64 age group primarily die as car drivers. The pattern is even more striking when "passive" (passengers) and "weaker" (unprotected) road users are combined:



Figures 34-35: Fatalities by age and transport mode, 2006 (Database: StBA, 2007)



Figures 30-31: Fatalities by age and road type for all transport modes, 2006 (Database: StBA, 2007)



Figures 32-33: Car drivers involved in injury crashes by age and light, 2006 (Database: StBA, 2007)

About two-thirds of older people die as passive and weaker road users, but "only" one-third of older people die as vehicle drivers. In contrast, among middle-aged adults who die, two-thirds are drivers and "only" one-quarter are passive and weaker road users, a ratio that is also seen when analyzing the mortality rates per 100,000 population (Figure 36). However, public transport is safest.

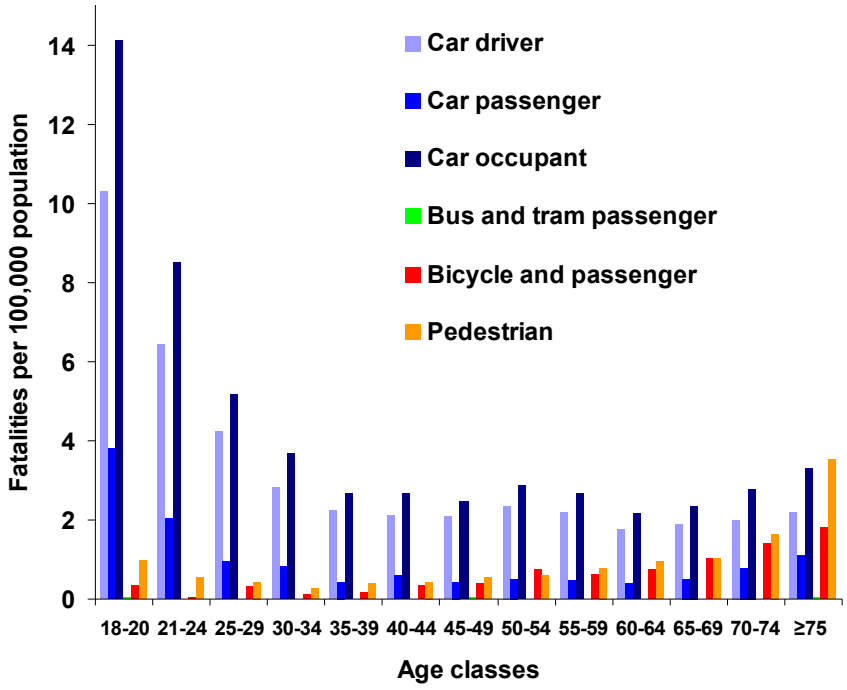


Figure 36: Fatalities per 100,000 population by age and transport mode, 2006 (Database: StBA, 2007)

Road users involved in accidents

Figure 2 in the introduction has already shown that only about 10 percent of people involved[6] in crashes with bodily injury (all modes of transport in road use) are older people. The rate of involvement per 100,000 population (Figure 3, repeated here as Figure 37) confirms the disproportionate low involvement of older people in crashes. As mentioned above, future research will be needed to determine current rates corrected for the number of kilometers traveled per year (on all travel modes) for the overall data on involvement in crashes that is presented here – an undertaking that has not yet been possible in a way that is methodically

[6] Definition according to German StBA: "As road users involved in a road traffic accident are recorded all drivers, vehicles riders and pedestrians who themselves – or whose vehicle – have suffered or caused [injuries or] damages. Passengers injured or killed are thereefore not considered [by definition] to be *involved* in in the accident."

satisfactory, given the lack of reliable, comparable exposure data (see subsection on *Older people and car crashes* for data on car involvement corrected for mileages traveled).

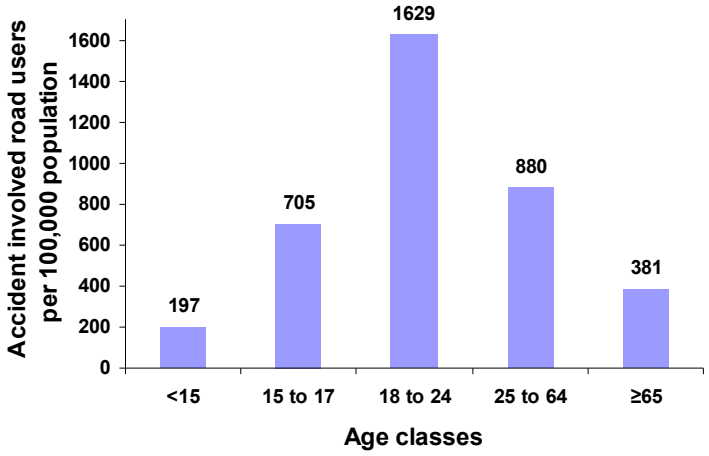


Figure 37: Number of people involved in traffic crashes per 100,000 population for all modes of road use, 2006 (Database: StBA, 2007)

Primary fault in traffic crashes

But how does the rate look for the subset of all people who are primarily at fault? Figure 38 shows the rate per 100,000 population. It leaves no doubt that as age increases, people are less often primarily at fault in crashes with bodily injury (for all modes of road use). The path of the curve also makes sense in terms of the low rate at which pedestrians are primarily at fault (see the subsection below); it is mainly as pedestrians that older people are innocently involved in crashes. Figure 39 shows the percentages of the total at-fault crashes with bodily injury for each age class (for all modes of road use): According to the graphic, older people were primarily at fault in 10.8 percent of all crashes, although they accounted for approximately 19.5 percent of the total population during the same year. But the following comparison (Figure 40) is particularly informative for assessing the risks posed by older road users: Subgroups within the group of middle-aged adults experience the same increase over a 30-year period in the percentage of crashes in which they are primarily at fault as do older people – the percentage of people over age 64 who are primarily responsible for crashes is not the only one that increases. All groups over age 35 show a worsening (reddish lines); all younger age groups exhibit a reduction and therefore an increase in safety (bluish lines). This raises the question of the trend within the group of older people, not least out of an interest in

gerontology and with a view to the debate on the competence to drive (such as the issue of age limits for driver's licenses; see Chapter 5). But the partial curves for the three selected elderly age classes obviously follow a comparable path (Figure 41). All of the older age classes, including everyone over age 35, are affected by the regrettable rise in the curve for people who were primarily at fault in past years. The data relates to three decades. Therefore, it also documents the effect of cohort-specific factors. Generally speaking, the responsibility for crashes is no longer distributed as it traditionally was (many young people at fault in crashes, adults somewhere in the middle, and a few older people) and behavior in road traffic seems to be getting more similar, a hypothesis that is not without justification.

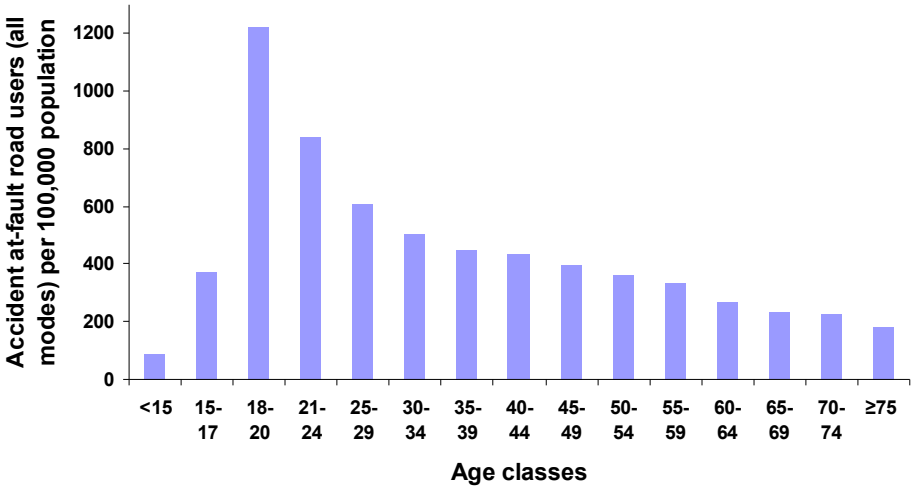


Figure 38: People primarily at fault in injury crashes for all modes of road use per 100,000 population of the individual age classes, 2006 (Database: StBA, 2007)

Finally, the distribution between the sexes: This offers very few surprises. Women are primarily at fault in just half as many injury crashes (for all modes of road use) as men (Figure 42). Reference must be made at this juncture to the presumed higher traffic exposure of men. However, it should also be noted that a plethora of international studies on risk behavior in road traffic – so many that they can hardly be documented – has identified one of the most influencing factors as gender. Based on the personality factors that are relevant for predictions, such as *sensation seeking, aggressiveness, conscientiousness*, *or competitiveness*, the behavior of men is significantly more risky than that of women – with a proven effect on crash rates (Kubitzki, 2007).

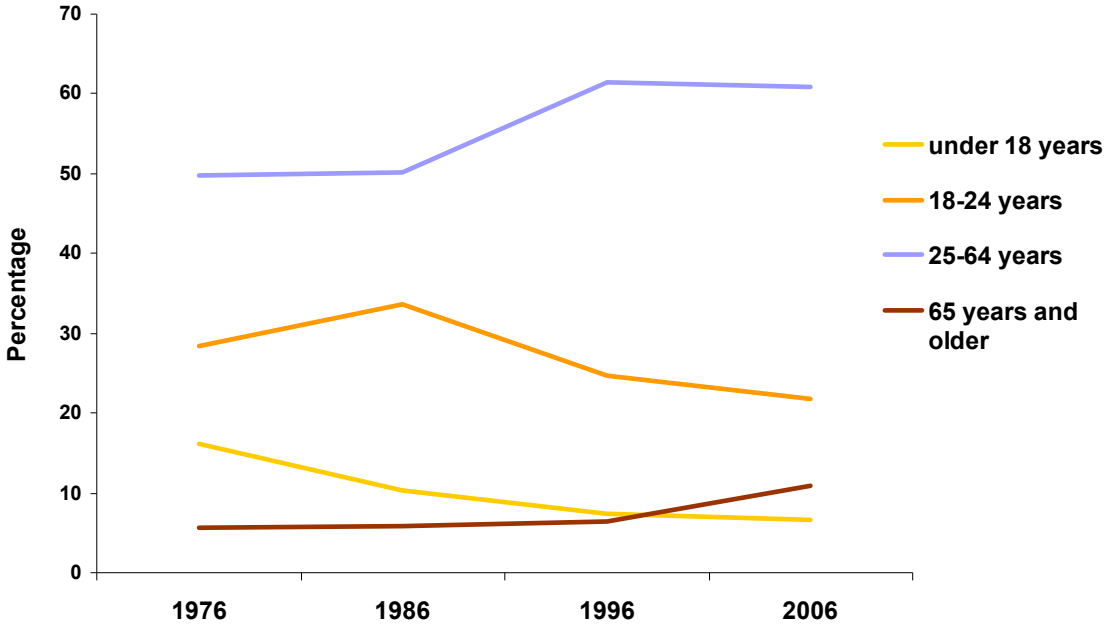


Figure 39: Percentage of people primarily at fault in injury accidents for all modes of road use over time (Database: StBA, 1977-2007)

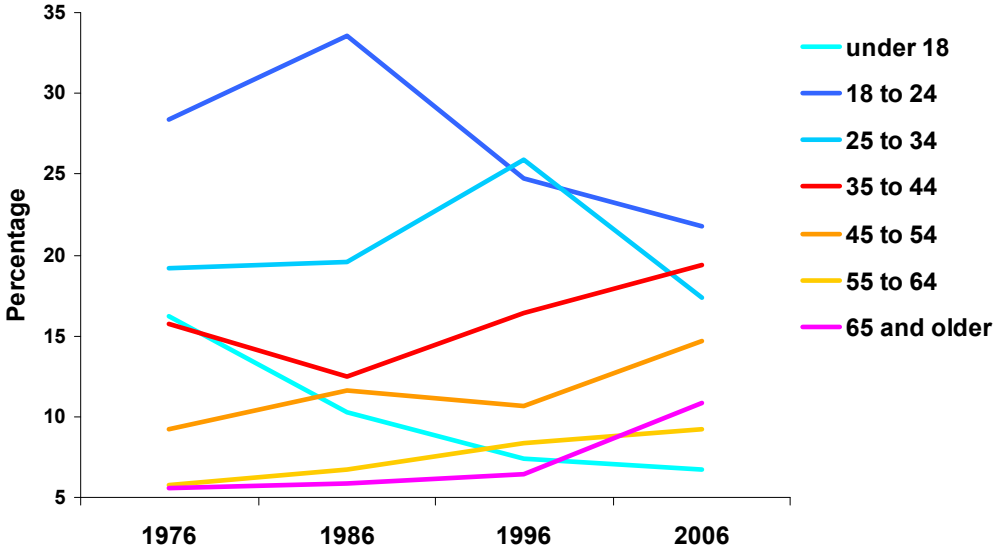


Figure 40: Percentage of people primarily at fault in all injury crashes for all modes of road use over time, divided into four middle-aged groups (Database: StBA, 1977-2007)

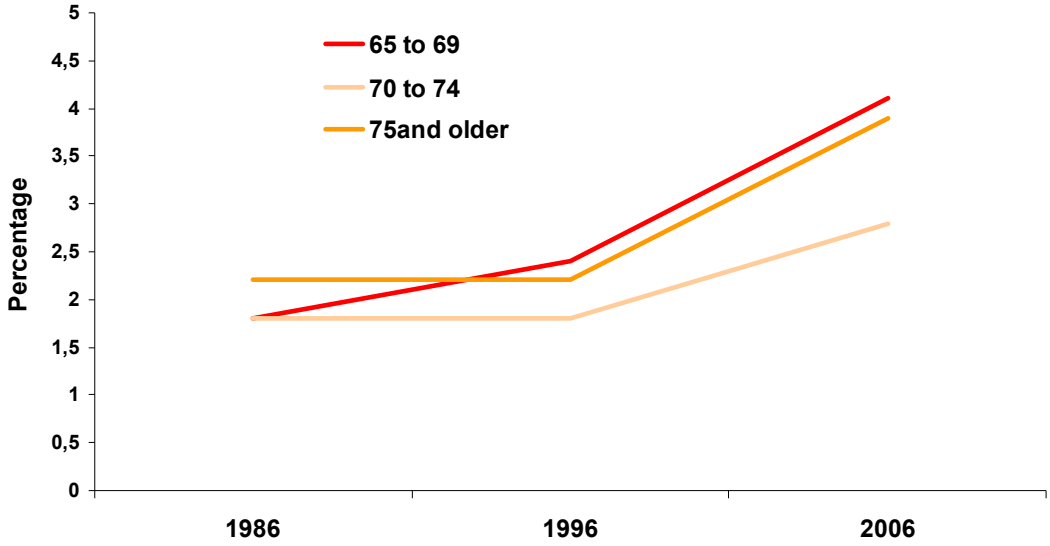


Figure 41: Percentage of people primarily at fault in all injury crashes for all modes of road use by three senior age groups over time (Database: StBA, 1977-2007)

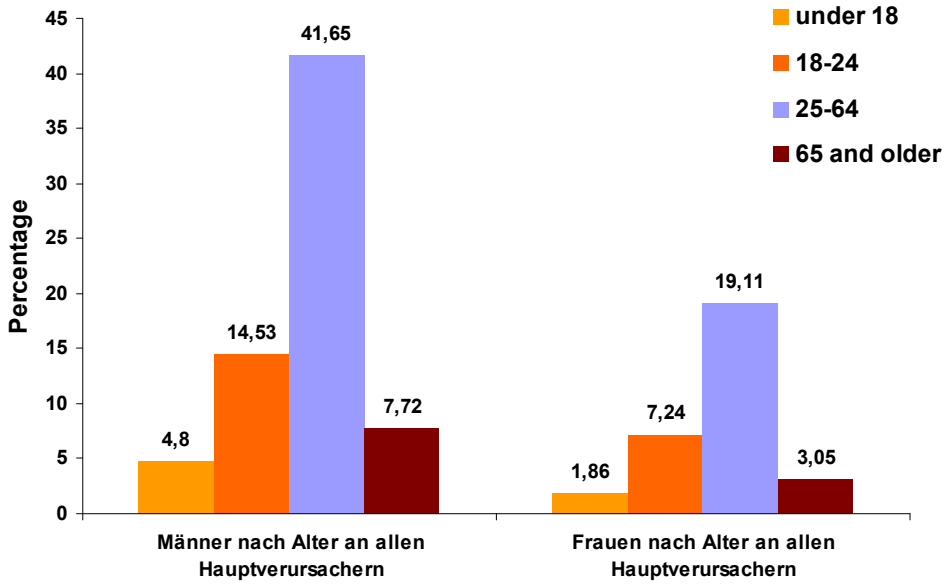


Figure 42: Percentage of people primarily at fault in injury crashes for all modes of road use, by sex, 2006 (Database: StBA, 2007)

At-fault rates

This rate is defined as the ratio of all people primarily at fault[7] to everyone involved. Everyone involved in traffic crashes means the sum of the people who are primarily at fault and people who are not primarily at fault (in Figure 43, for example, 70 percent of all car drivers in the 18-20 age group who were involved in injury car crashes were also primarily at fault in the car crash). This rate, which is expressed as a percentage, should not be confused with the percentages of the age groups in the total of all people who are primarily at fault, as discussed above (e.g., in Figure 39, 10.8 percent of all people who are primarily at fault in injury crashes for all modes of road use are 65+). In contrast, Figure 43 shows that older drivers of cars (the same applies to trucks and buses) tend to be primarily at fault when they are involved in a crash. A more critical pattern for bicyclists does not appear until the group of older elderly ($\geq$ 75). However, the curve for pedestrians is important. Contrary to the general opinion, older people bear the primary responsibility for crashes in which they are involved as pedestrians less often than all younger people do. While it is certainly important to address older pedestrians (wearing visible clothing, etc.), measures to promote safety must always keep other road users in mind (watching out for elderly pedestrians). Figure 44 also documents the fact that in the distribution between the sexes, male bicyclists and pedestrians are primarily at fault in crashes far more than women are. Older women car drivers do slightly worse.

Summary

Based on their share of the population, older road users die disproportionately, whether in urban or rural areas, usually during the day, and above all as the "weaker and passive road user" (pedestrian, cycle traffic, passenger), but they account for a much lower percentage of everyone who is primarily at fault, when looking over all accidents with injuries over all modes of road use. Their involvement and at-fault rates per 100,000 population are below the levels for younger and middle-age adults. Based on all modes of road use, the assumption of an increased risk for older road users in Germany must be rejected, notwithstanding the fact that crash rates corrected for travelling exposure or mileages (over all modes of road use) respectively cannot be determined in a way that is methodically satisfactory.

[7] Definition of the StBA: "The road user mainly responsible (Hauptverursacher [first party involved]) is the person who in the opinion of the police is chiefly to blame for the accident. Road users involved in single vehicle accidents are always regarded as mainly responsible [at-fault]."

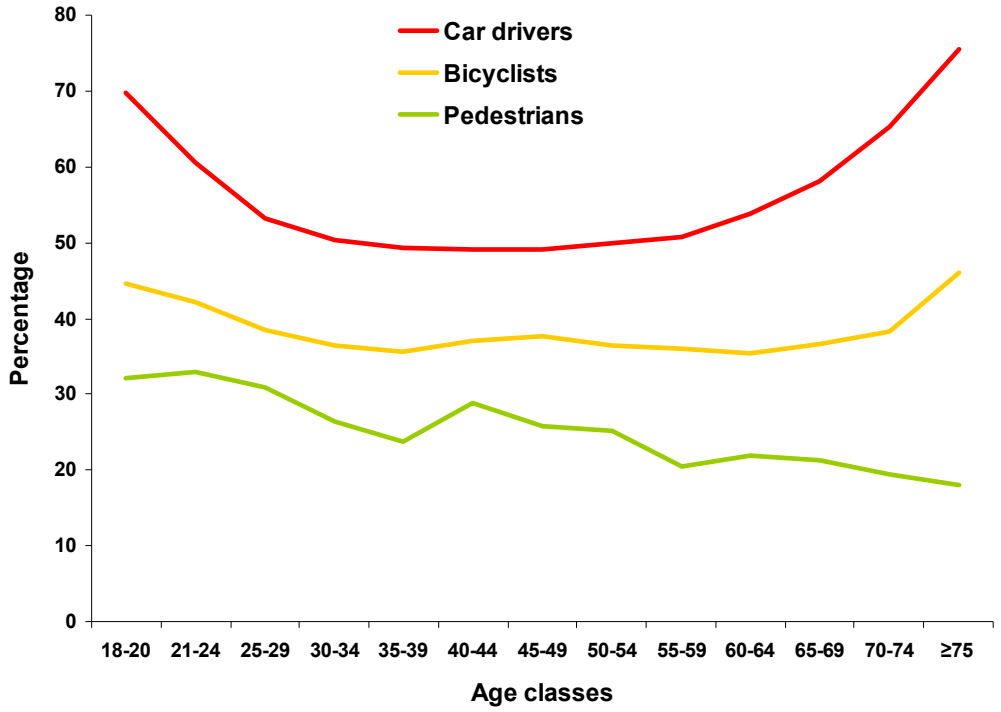


Figure 43: At-fault rates by age for car drivers, bicyclists, and pedestrians, 2006 (Database: StBA, 2007)

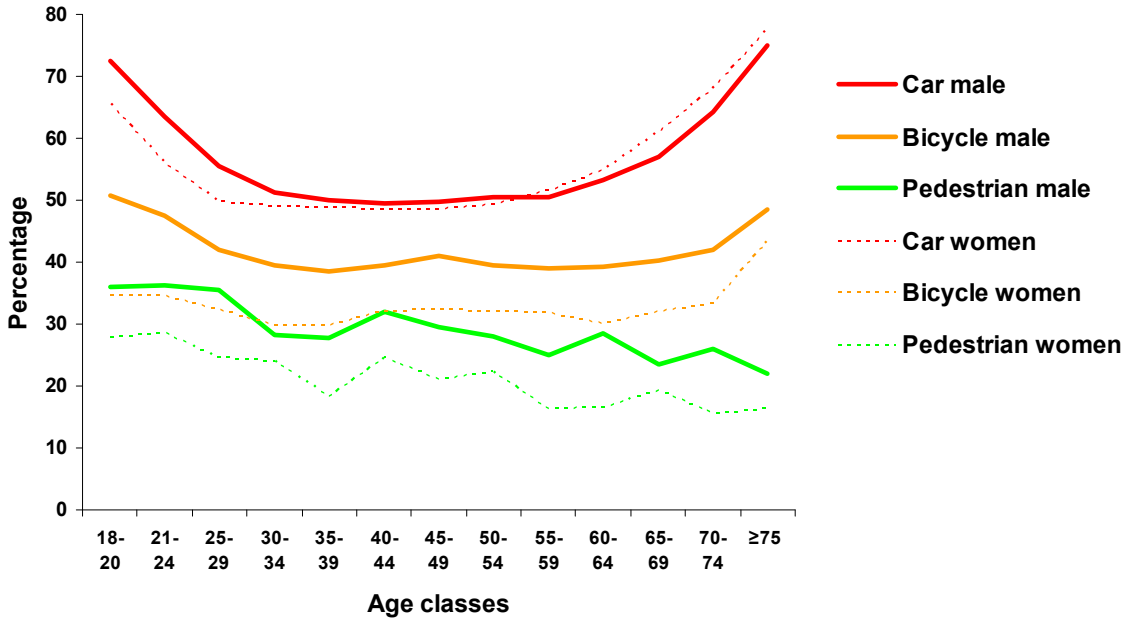


Figure 44: At-fault rates by age and sex for car drivers, bicyclists, and pedestrians, 2006 (Database: StBA, 2007)

4.1.2 Older people and car crashes

All modes of road use have been discussed above, and now the safety of individual transport modes will be explored. First, the car. The main accusation against seniors is that they are a threat to public safety when they drive a motorized vehicle. In that regard, mileages can also plausibly be included, although this is subject to methodical limitations. We start with giving the fatalities figures:

Fatalities in all car occupants

In Germany, approximately 16 percent of all car drivers and 19 percent of all passengers who are killed in cars are older people (65+), while approximately 55 percent of car drivers and 36 percent of passengers who are killed in cars are middle-aged adults (StBA, 2007). Figures 45 and 46 document the difference discussed above in the risks to older people as car drivers and car passengers (the sum equals the number of car occupants) over ten years.

The mortality rates per 100,000 population are higher for older passengers. They are lower for older drivers than for middle-aged drivers, but it can be seen clearly that the downward trend for older people is much weaker. A biological influence that is reflected in the reduced effect of passive vehicle safety standards as a result of the greater vulnerability of the elderly can only be presumed here; this issue must be resolved by future biomechanical research. Figures 47 and 48 show the difference between the sexes. Women passengers are at greatest risk.

Finally, a look at fatalities among car drivers (not including passengers) according to mileages driven in Germany (Figure 49). Fatality data from 2002 were used for the purpose of comparability; the age classes in the lower range had to be adjusted. An additional limitation that applies here, as well as further below, is that the car driving mileages according to Hautzinger, et al. (2005) relate only to private vehicles. The mileages driven by commercial car drivers were collected separately and published in different age classes. The additional mileages traveled commercially by car is split, with drivers in the 30-59 age group accounting for approximately 84 percent and drivers under age 30 and over age 59 accounting for only about 8 percent each. In contrast, the percentage of commercial drivers in the national accident data that is available from the German Statistical Office is unknown.

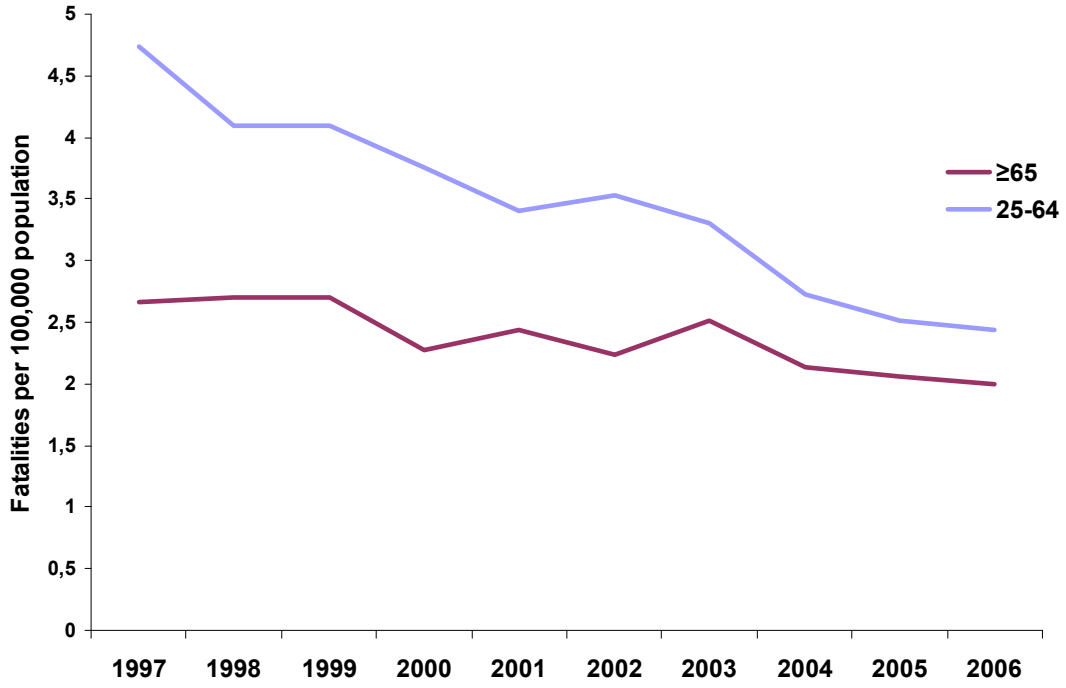


Figure 45: Mortality rate of car drivers per 100,000 population over time (Database: StBA, 1998-2007)

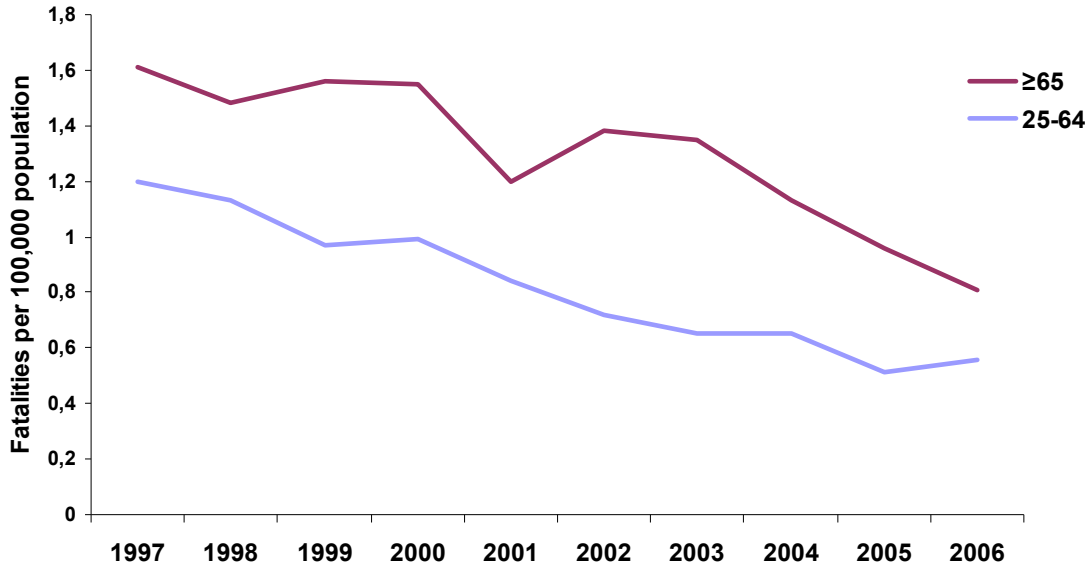


Figure 46: Mortality rate of car passengers per 100,000 population over time (Database: StBA, 1998-2007)

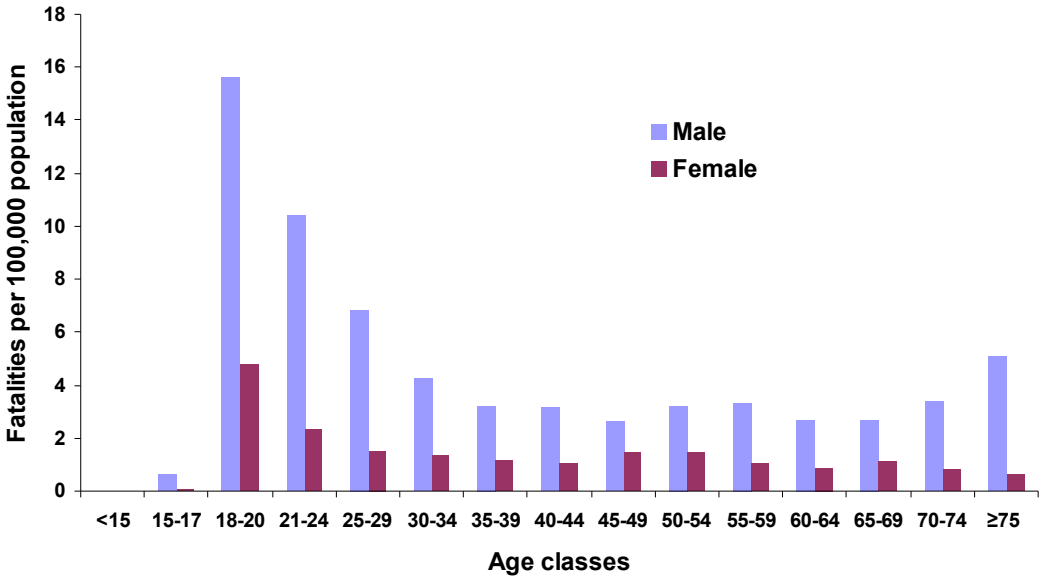


Figure 47: Mortality rate of car drivers per 100,000 population by age and sex, 2006 (Database: StBA, 1998-2007)

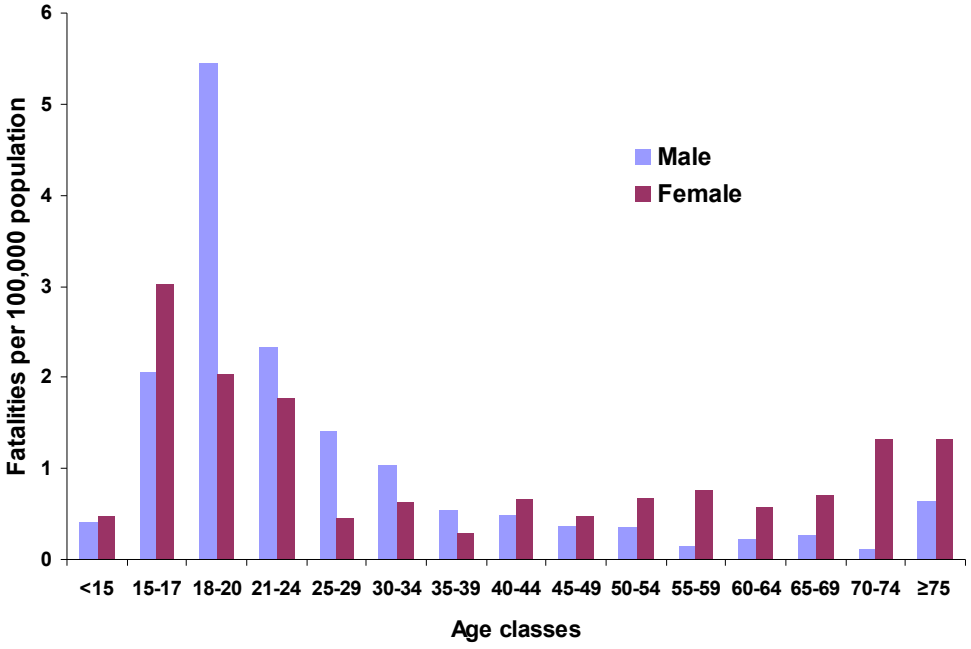


Figure 48: Mortality rate of car passengers per 100,000 population by age and sex, 2006 (Database: StBA, 1998-2007)

Therefore, all rates corrected for mileage must be interpreted subject to certain limitations, although they are certainly able to provide a rough picture. One can presume that the low points for the 30-59 year age group will be slightly lower and that the peaks for the other age groups will change very little. Subject to that limitation, older car drivers seem to be at greater risk than middle-aged drivers, although only half as much at risk as younger drivers; the younger elderly have the same rate as drivers in the 25-34 age group. The rate doubles from the younger elderly to the older elderly. However, mileage related death risk it is much lower for seniors car drivers than for younger drivers up to age 24. The situation appears similar for all car occupant fatalities (Figure 50) – rather, it appears to intensified against the background of the known problem of young (male) drivers with their young (male) passengers.

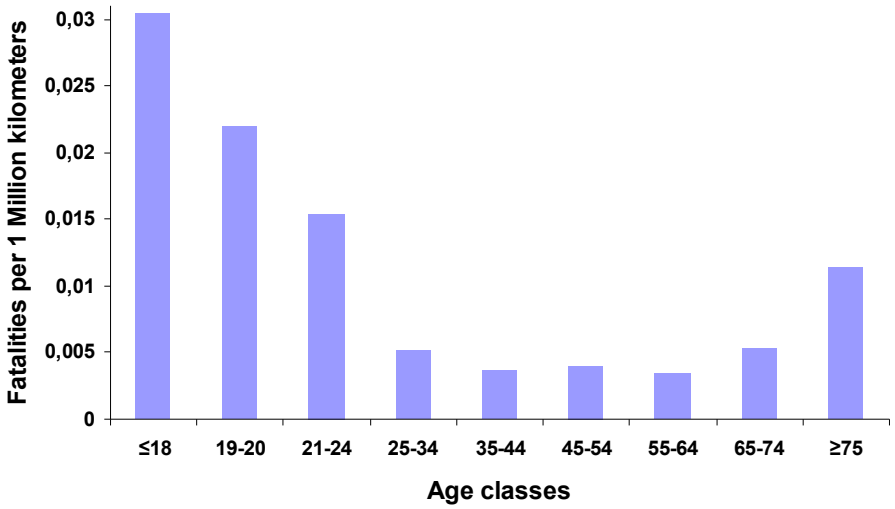


Figure 49: Mortality rate of car drivers per 1 Million kilometers driven annually by private car drivers, by age, 2002

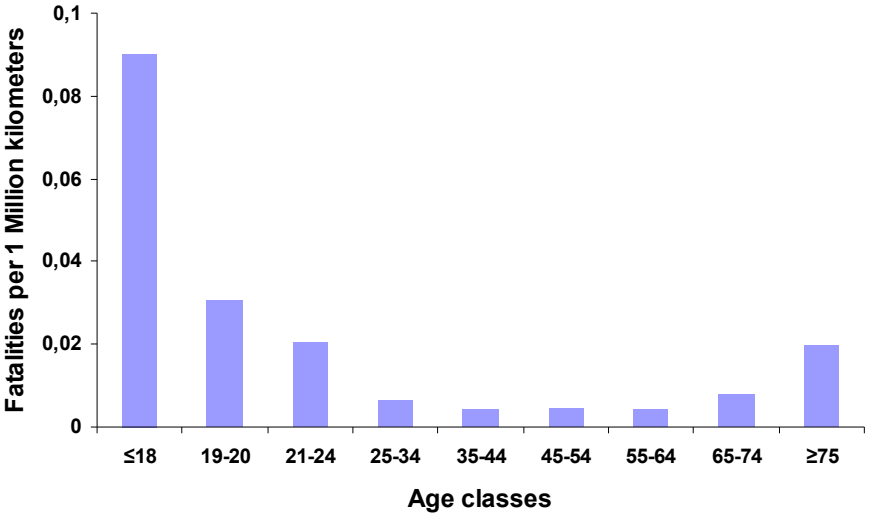


Figure 50: Mortality rate of car occupants per 1 Million kilometers driven annually by private car drivers, by age, 2002 (Database: StBA, 2007)

Fatalities in all car occupants by location

Only a rough overview of the distribution of car occupant fatalities by location will be provided here (Figure 51). Older car occupants tend to die in rural areas, as do the middle-aged, but older people die twice as often in cities and towns as the middle-age do. In contrast, older people are killed only half as often on the freeway. The risk to seniors on rural roads is familiar, but it should not be forgotten that 27 percent of fatal car crashes involving older people as occupants were on urban roads and freeways.

	Car occupant fatalities			
	Older people (65+)		25-64 years	
	Absolute number	%	Absolute number	%
Urban	71	15.5	114	8.4
Rural	334	73.0	930	68.9
Highway	53	11.5	306	22.7

Figure 51: Frequency distribution of car occupant fatalities by location (Database: StBA, 2007)

Involvement in car accidents

In 2006, 38,616 older drivers (9.9%), 264,755 middle-aged drivers (68.1%), and 84,891 young drivers (21.8%) were involved in car crashes with personal injury (the remainder were younger than 18, bringing the total to 100%) (StBA, 2007). This shows that the accident involvement distribution for senior car drivers also differs from the percentages of this group in the general population. Figure 52 shows the rate per 100,000 population, and Figure 53 shows the rate per 1 million kilometers mileage. Based on the general population, older car drivers are involved in accidents far less than half as often, based on mileage, older people are involved in accidents somewhat of a quarter more often than middle-aged people and half as often as younger people. Other distinctions by age in this context would show that the younger elderly are still comparable with the 25-34 age group (see above on the redistribution of mileage classes and the ability to interpret them).

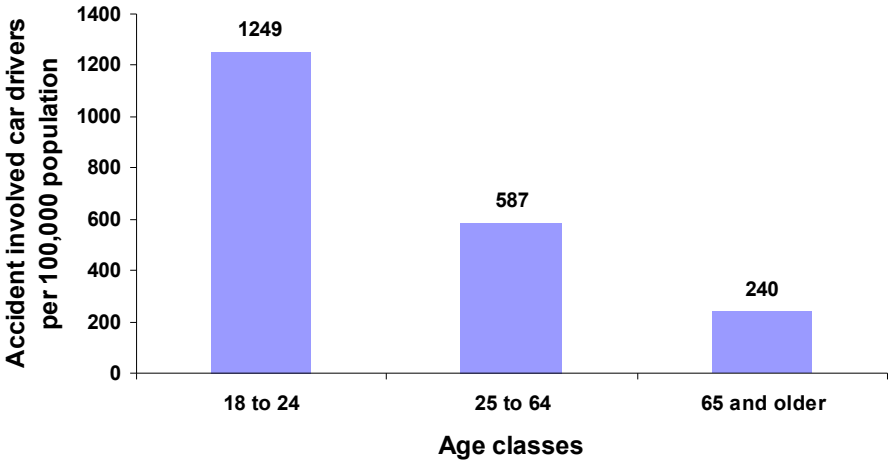


Figure 52: Car drivers involved in injury crashes per 100,000 population for each age class, by age, 2006 (Database: StBA, 2007)

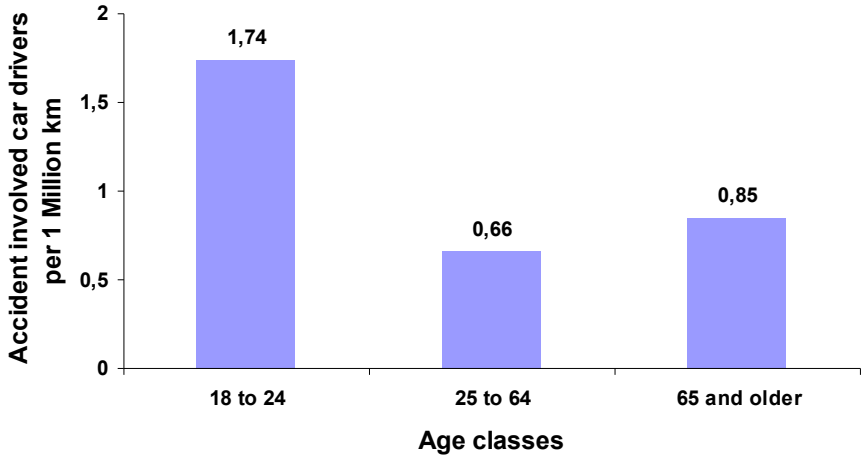


Figure 53: Car drivers involved in injury crashes per 1 million kilometers driven, by age, 2006 (Database: StBA, 2007)

Single-car accidents

Single-car crashes also affect the image of older drivers in a distinctive way. Single-car crashes were calculated for this study broken down by age and their variation over a ten-years period (1997 and 2006) in a special analysis done by the German Federal Statistical Office (2008). Figures 54 to 56 document (a) absolute numbers (Figure 54), (b) crash rates based on population (Figure 55), and (c) crash rates based on car mileages[8] (Figure 56). Only older dri-

[8] The available data on car mileage relates to 2002 and is used here subject to reservations concerning the ability to interpret rates. The available data contains a different age classification for young drivers. For

vers experience very slight growth, but at the lowest level for all age classes. After correcting for mileage, older drivers are at the same level as middle-aged drivers. The rate for older drivers has worsened over the past ten years to the same extent as it has improved for middle-aged drivers – this must, of course, not be neglected. Again, young and novice drivers are of greatest concern in this area, too. Single-car crashes with bodily injury or major property damage primarily occur in rural areas.

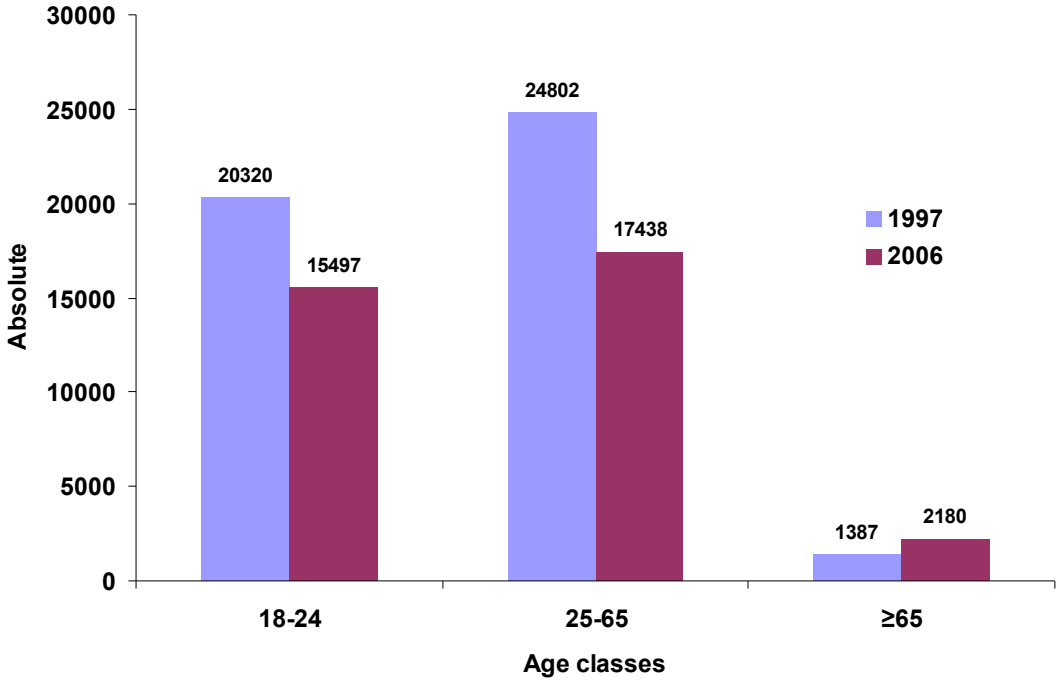


Figure 54: Single-car crashes – in absolute numbers – by age over time (Database: StBA, 2008)

This report will be able to deal only marginally with the issue of safety equipment and the average age of vehicles (see section 4.3). But based on known data about them (StBA, AZT) it cannot be excluded that older people at least tend on average to drive somewhat older cars and cars with fewer safety features (such as ESP). Those features could at least help to avoid single-car crashes on rural roads. Overall, however, the available data on single-car crashes does not indicate that older people are exposed to this risk of single-car crashes more than others.

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the group of single-car crashes involving people in the 18-24 age group, the distance driven by everyone under age 25 is included in the calculation subject to reservations (see above).

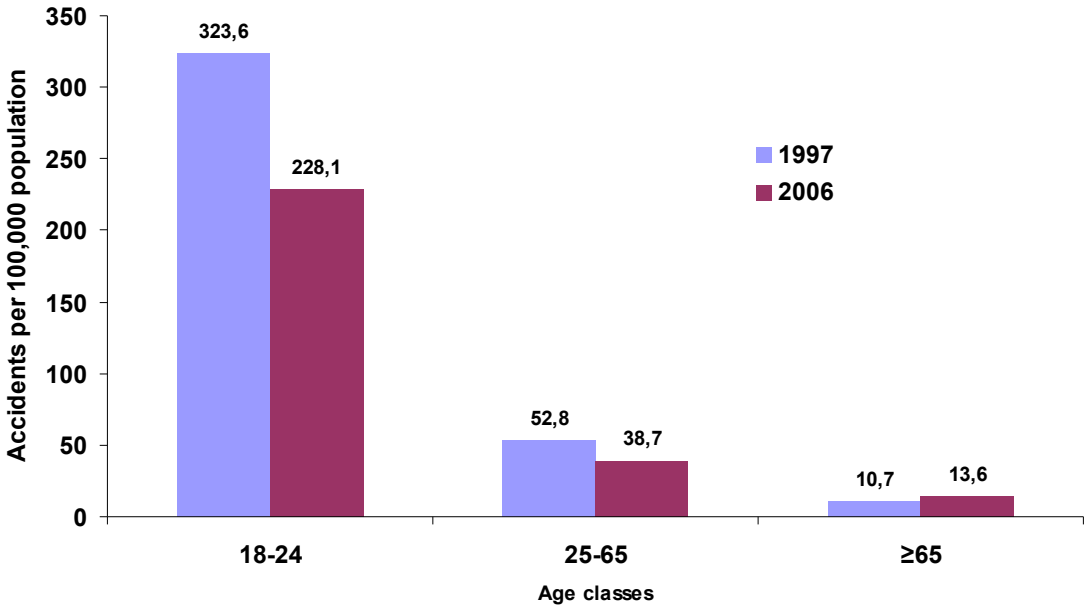


Figure 55: Single-car crashes – per 100,000 population – by age over time (Database: StBA, 2008)

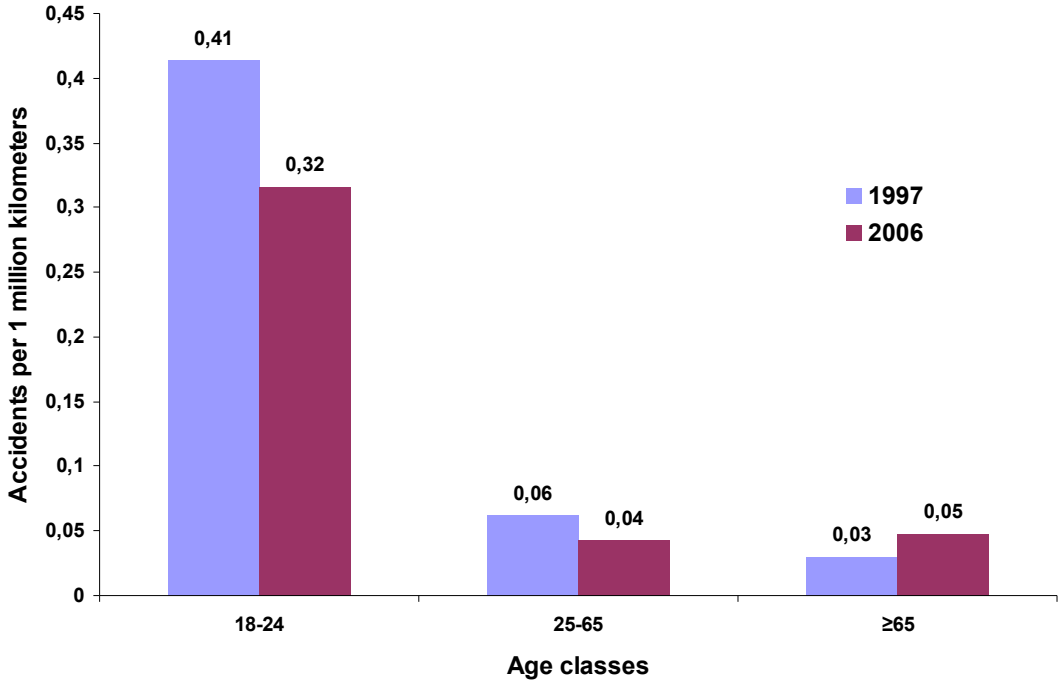


Figure 56: Single-car crashes – per 1 million kilometers – by age over time (Database: StBA, 2008)

Primary fault in car crashes

Figure 4 has already shown that, corrected for population, older people cause the fewest car crashes with bodily injury and major property damage. Figure 57 shows the rate per 1 million kilometers total annual private car driving. The risk posed by car drivers generally takes center stage when older road users are being discussed. Therefore, all at-fault crashes with major property damage were also included in rates based on car mileage, while most of the data presented here is limited to crashes with bodily injury only.

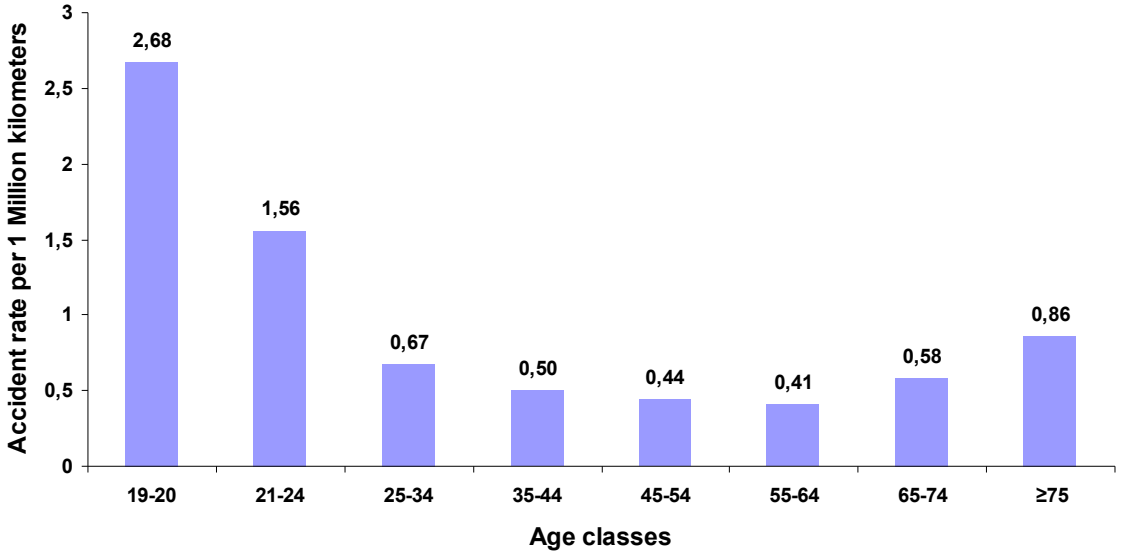


Figure 57: Crashes with bodily injury and with major property damage, in which car drivers were primarily at fault, by age, per 1 million kilometers total annual driving in private cars, 2002 (Database: StBA, 2003)

The most important group of at-fault car drivers, which is novice drivers, was divided into two groups, under 20 and ages 21-24, due to the available German federal crash and the mileage data. Figure 58 applies the mileage data for 2002 to the most recent crash data for 2007. It again becomes clear that the young elderly are (a) far better than young and novice drivers and (b) still slightly better than those in the 25-34 age group. The older elderly are still much better than "young drivers" and novice drivers (reference year 2002). Applying the driving distances for 2002 to the crash figures for 2007 shows a worsening for older people (against 2002) and an improvement for almost all other age groups. But the methodology would allow this rate only if the percent of each of the age groups in the general population had not changed. In actuality, the percentage of all non-elderly people decreased from 2002 to 2007,

while the percentages of all elderly groups increase; this doubtless may affect total driving mileage, particularly since it was shown above that increases in the number of cars registered or the licensing rate are taking place precisely among the group of older people. Anyway, new mileage data wait to be available. Finally, even according to this raw way calculation (which is to the detriment of older drivers), the young elderly are shown to be only half as dangerous as the 21-24 year age group, and the older elderly are shown to be slightly less dangerous.

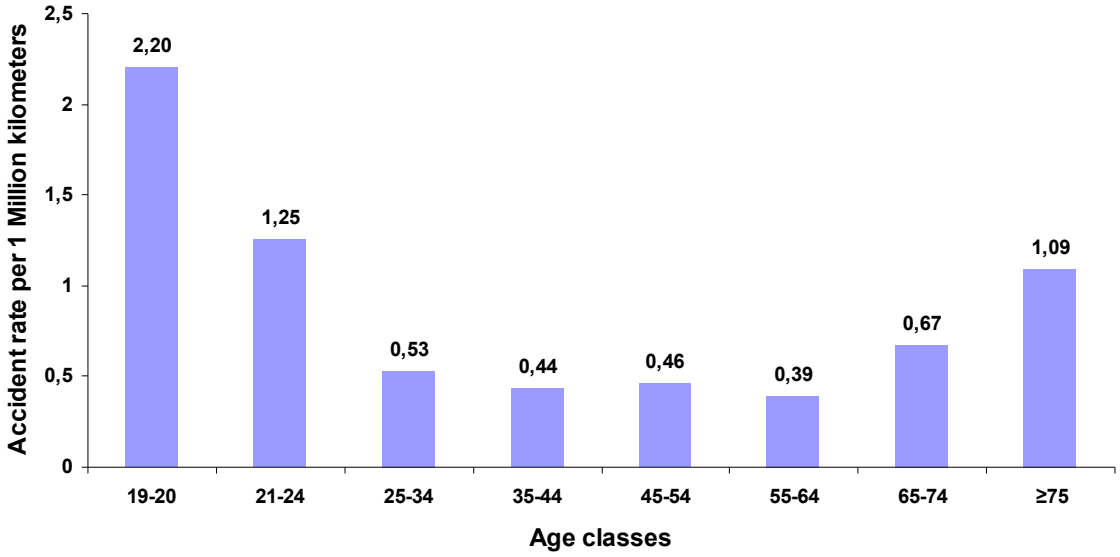


Figure 58: Crashes with bodily injury and severe property damage, in which car drivers were primarily at fault, by age, per 1 Million kilometers total annual driving in private cars, 2007 (Database: StBA, 2008)

The rates shown in Figure 58 above should at most be interpreted as a critical indication that it will be necessary to keep a close eye on the observed increase in crash rates for older people which has recently occurred. Figure 59 shows the trend for the absolute number of crashes over ten years according to a more detailed age classification, in order to illustrate where most accidents still occur.

Now again for car drivers, the percentages for the age groups out of the sum of all at-fault car crashes with bodily injury. Figure 60 shows, as has already been seen in the at-fault distribution over the accidents of all modes of road use, that older people are at fault in 11.8 percent of car crashes, the lowest percentage of all adults, although this percentage has increased over the past few years, in contrast to the total 25-64 age group. However – as shown above – it is also true for car drivers who are primarily at fault that the comparison with subgroups within the middle-aged group looks different. Everyone over 35 shows an increase.

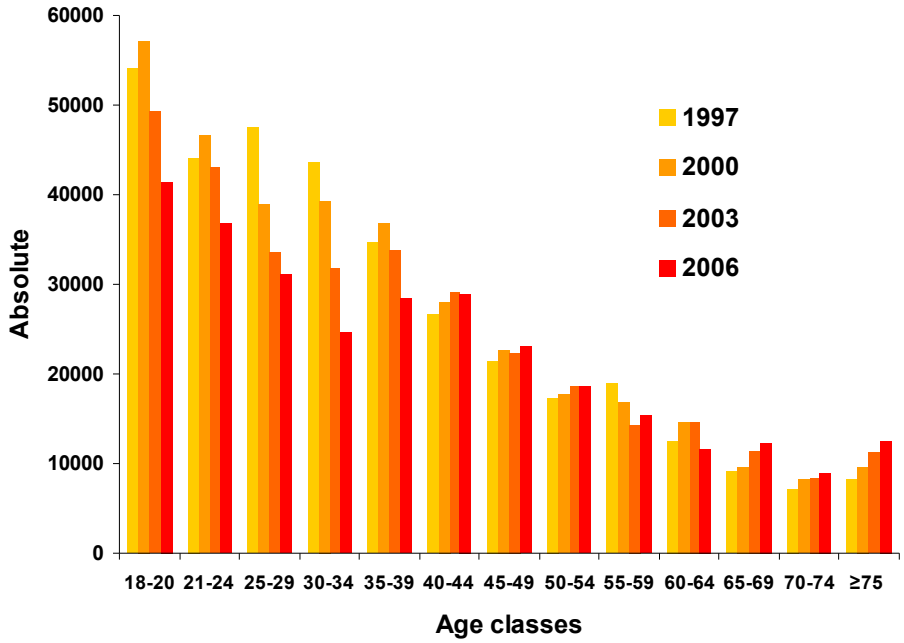


Figure 59: Crashes with bodily injury and major property damage, in which car drivers were at fault (absolute numbers) over time by age (Database: StBA, 1998-2007)

It is thus in no way solely age-related, although this question cannot be completely answered based on this analysis of the data (Figure 61). Figure 62 again shows that the increase can be observed within all three older age classes and not just for the older elderly.

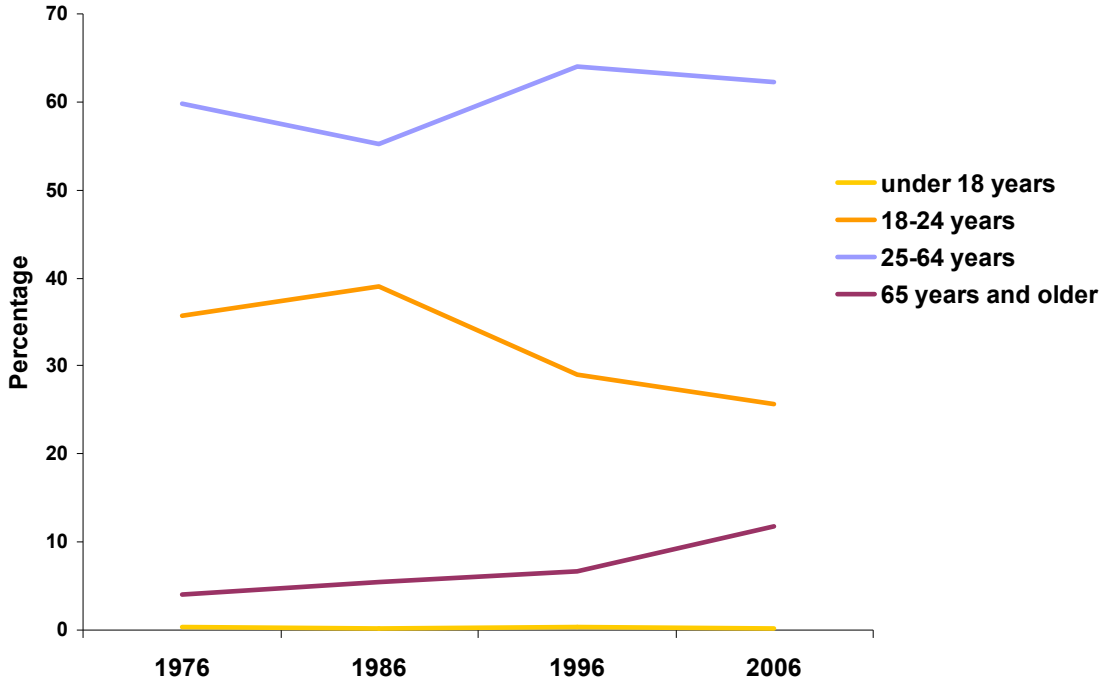


Figure 60: Percentage of at-fault car crashes out of all car crashes with bodily injury, by age over time (Database: StBA, 1977-2007)

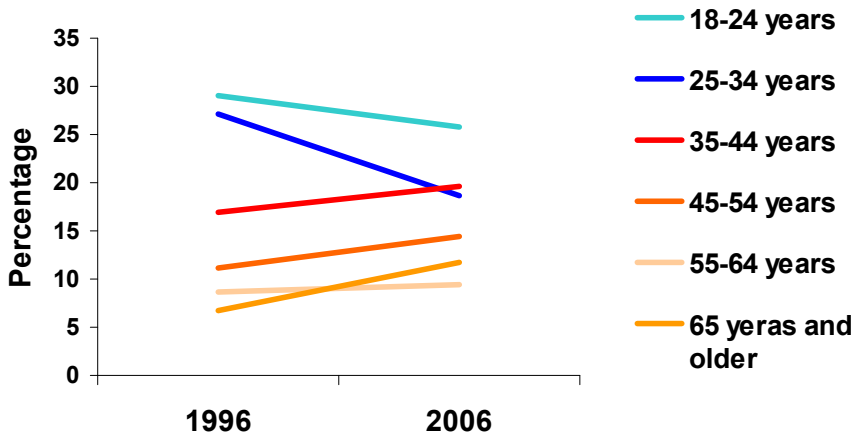


Figure 61: Percentage of at-fault car crashes out of all car crashes with bodily injury, by age over time, divided into four middle-aged groups (Database: StBA, 1997-2007)

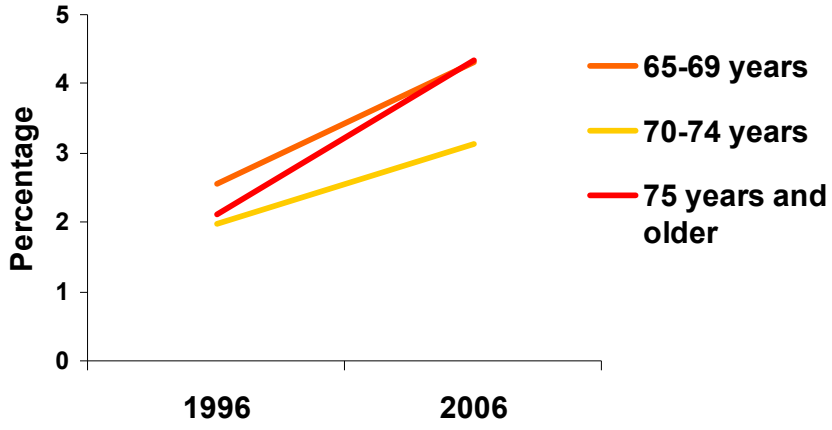


Figure 62: Percentage of at-fault car crashes out of all car crashes with bodily injury, by age over time for three older age groups (Database: StBA, 1997-2007)

At-fault rates in car crashes

The primary at-fault rate for car drivers has already been presented (see Figures 43 and 44). A separate analysis over a 30-year period clearly shows the multi-year stability of age as a factor, which means it is independent of the cohort. The result is a very congruent pattern (compare Figure 63). The curve for 1976 is not as smooth because broader survey groups were used at the time. The stability shown by these curves is not confirmed for pedestrian and bicycle traffic (see above and, for more details, sections 4.1.3 and 4.1.4). This stable age factor should not be neglected for issues related to efforts to make improvements for older car drivers; not-

withstanding the issue of the general risk of car crashes involving older people, it is also seen here that whenever older drivers are involved in a crash there is a greater likelihood that they bear primary responsibility and that age-related factors play a role.

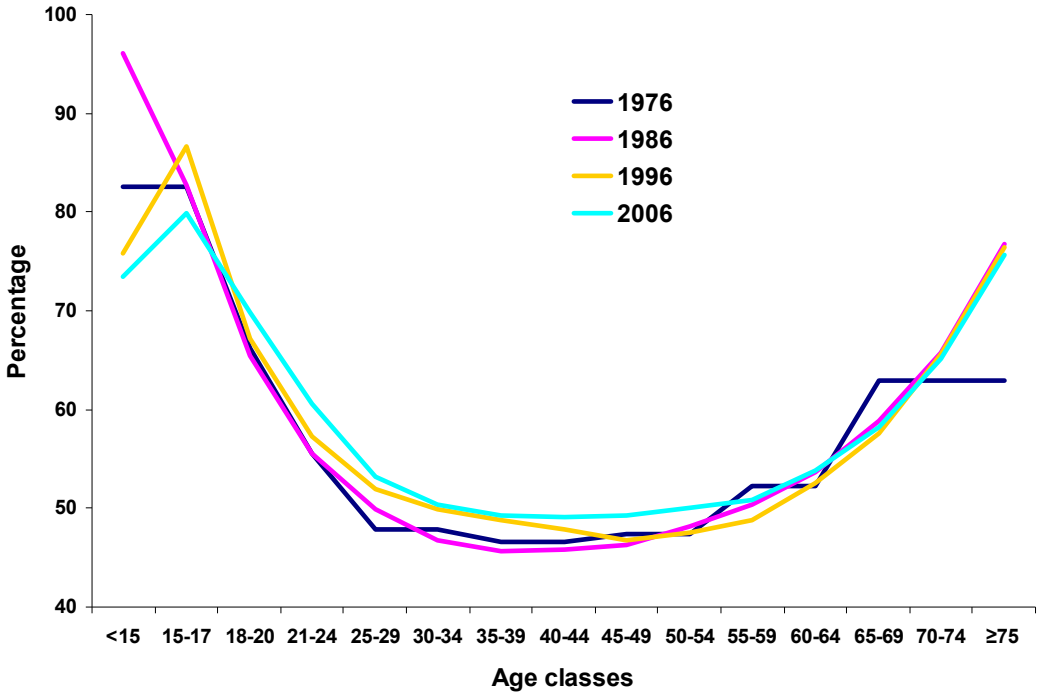


Figure 63: Primary at-fault rates in car drivers by age over a 30-year period (Database: StBA, 1977-2007)

Seniors as car occupants – Conclusion

Are older drivers more dangerous than other drivers? All of the above analyses and calculations show that the answer to this question depends on the type of comparison that is made. It is undisputed that the past ten years have seen an increase in crashes involving cars with older drivers. But that is also the case for younger groups of drivers. If we take the criticism linked to crash rates seriously, it must be emphasized that ultimately only "young drivers" and novice drivers can point to an improvement – they have been the greatest beneficiaries during the corresponding decade. All car drivers over 35 are benefiting less from the overall trend for the general safety of road traffic.

Is it possible – as is unfortunately commonly called for all too often, even by experts on transport – to use crash data that has been corrected for driving mileages as the sole benchmark for assessment? And to do so when it is difficult to apply exposure data to current crash

data? The younger elderly in particular must not shy away from this comparison. But this comparison is poor. Plausible measures of exposure for determining the probability of having a road accident are still difficult to find; consider only the aforementioned issue of actual use of the road by the various age groups. Putting the number of fatalities into perspective by considering them in relation to the general population ultimately remains open to criticism. It should be noted at this point that the quantity of data described above did not make it seem advisable to present all results that point in the same direction. But as shown by Annex 2, the various crash and casualty rates per 100,000 class B driver's licenses (car) for 2004 (the same as the most recent BASt data) and per 100,000 registered cars for 2006 also support the above conclusions.

The findings of international research, showing that it is precisely the correction for distance traveled that appears to be important for older groups, have not yet been taken into account. That is because older people who drive longer distances are safer than older people who do not travel as far (Hakamies-Blomqvist, Raitanen & O'Neill, 2002; Langford, Methorst & Hakamies-Blomqvist, 2006). If only groups that travel the same distance are compared, the curves of the crash rates are more complex (Figure 64). The critical limit is less than 3,000 kilometers. All other drivers suppose to have a much more equal risk development by age. Where this issue is concerned, research must also be done on older people in Germany. To summarize, what has been said for crashes and casualties in all modes of road use is true for car drivers: The younger elderly (65-74 years) are experiencing a slight increase in crashes, but they are still better than the 25-34 year group. The older elderly exhibit an obvious increase in crashes, twice that of the younger elderly; however, in some cases it is only half as great as for "young drivers." The majority of all curves can therefore be read as a "*ski jump*" or "*hockey stick*" function (many young people, a decline for the middle-aged, a slight increase again for the elderly). Only the at-fault rate follows the most cited u-shaped curve. Finally, there remains the fact that only 12 percent of all at-fault car crashes are attributable to older people and only 4.4 percent to the "older elderly" (≥ 75).

Older drivers therefore cannot be considered to be disproportionately dangerous on the road. At the same time, that view does not exclude problems related to competence or fitness to drive in individual cases (individual risks). An assessment based on overall federal crash statistics cannot be interpreted as carte blanche to forget the fact that as people age it is more likely that specific risk factors will appear. But this factors are not the sole predictors of the

occurrence of a loss event. Issues such as illness, intake of mediations, or characteristic driver errors which occur among the elderly are explored in Chapter 5. Older car passengers are at much greater risk than other elderly people. In particular, older women have not equally benefited from improvements in safety over past decades. This can hardly be blamed on vehicle technology alone, but it does bear some responsibility. Future technological developments will have to take into account the increasing percentage of older people (who are physically smaller and weaker) both as drivers and as *passengers* in cars.

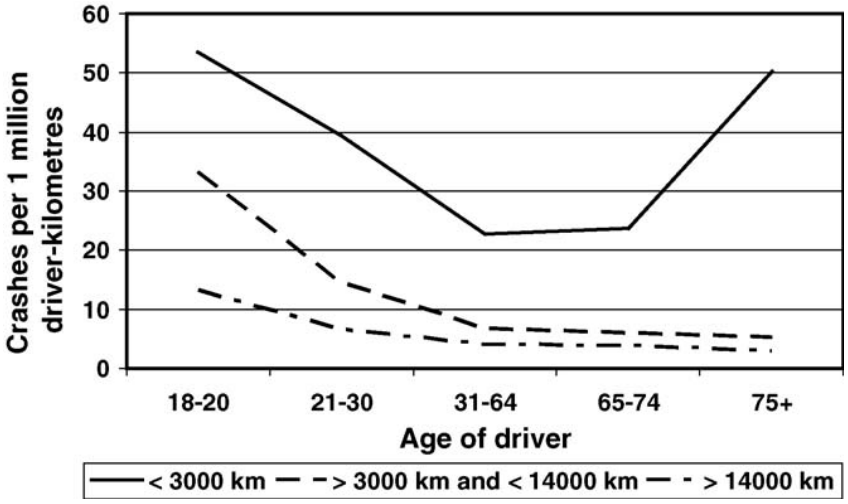


Figure 64: Crash rates by age and car mileage, comparing age groups that travel the same mileage per year, according to a European study (no German data) (graphic cited according to Langford, Methorst & Hakamies-Blomqvist, 2006)

4.1.3 Older people and pedestrian crashes

Older pedestrians are one of the groups of road users who are at greatest risk, while at the same time – contrary to what is commonly thought – they pose the lowest risk to others. Just 12.7 percent of all pedestrians who are primarily at fault in injury crashes are older people (33.3% are middle-aged). In contrast, 51 percent of all pedestrian fatalities involve people over age 64, while "only" 34 percent are in the 25-64 age group (StBA, 2007). Figure 65 shows the mortality rates over time. It clearly indicates that walking is becoming safer for older people faster than it is for middle-aged adults. But it also shows that older pedestrians still die more frequently than people in the 25-64 age group. Almost all pedestrians are killed in urban areas. The EU data (see section 4.2) will show that this is a problem for the safety of older people throughout Europe and that it must remain the focus of safety efforts.

Accordingly, with 5,625 casualties at pedestrian crossings (no age distinction, according to StBA, 2007) out of 31,916 pedestrian casualties in urban areas (20 percent of them older people), using the ratio simply to develop a hypothesis will show that over 1,100 older pedestrians, most of whom have done nothing wrong, die in zebra crossings each year. For example, their behavior in pedestrian crossings is significantly more defensive and they allow more vehicles (motor vehicles and bicycles) to pass before they cross (Draeger & Klöckner, 2001). Traffic signal programs are designed for a walking pace that older people frequently cannot manage (ibid.), and there are currently plans to eliminate official hazard sign 134 (caution, "pedestrian crossing") in Germany.

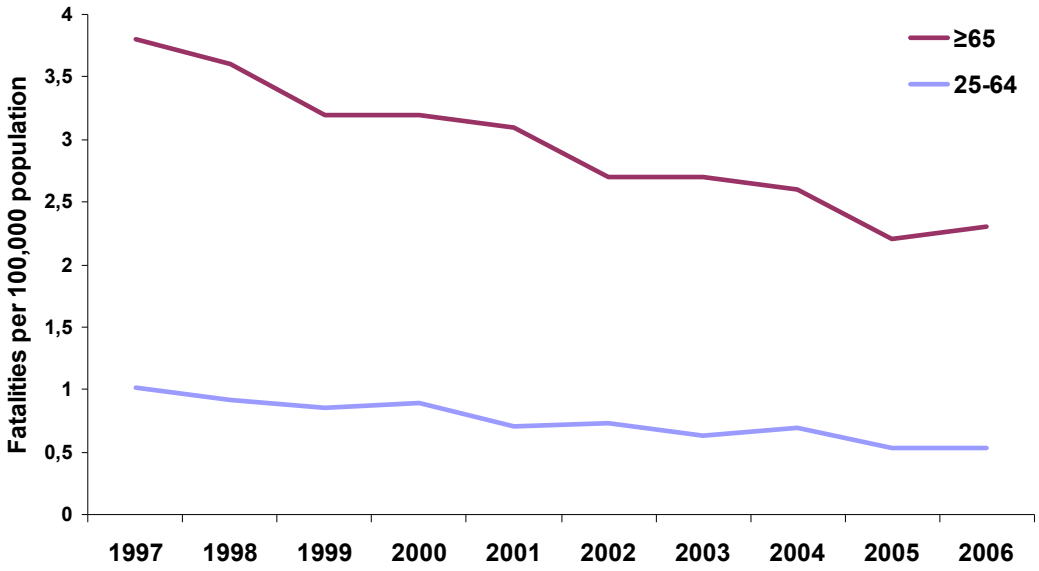


Figure 65: Pedestrian fatalities per 100,000 population in two age classes over time (Database: StBA, 1998-2007)

Figure 66 next page shows that male pedestrians are at much greater risk than females. It cannot currently be said with certainty whether this is attributable to the greater exposure of men (kilometers traveled on foot, length of trips, and time spent walking). Hautzinger, et al. (1996, cited according to Schlag & Megel, ed., 2002) calculated risk indicators for crash data from 1991 on the basis of casualties per 1 million hours of road use. The casualty risk for men (65-74 years) was 2.8, compared with 3.4 for women of the same age; in the ≥ 75 group the ratio was 6.5 for men to 9.7 for women. However, the data has changed in the meantime. The percentage of older people who are primarily at fault in all injury crashes in which pedestrians from all age groups are primarily at fault, as for all other types of road use, is well below the

corresponding percentage of older people in the population (Figure 67). The curve over the past ten years again shows the familiar slight increase, but this would also occur in younger adult age groups if they were divided further (no graphic).

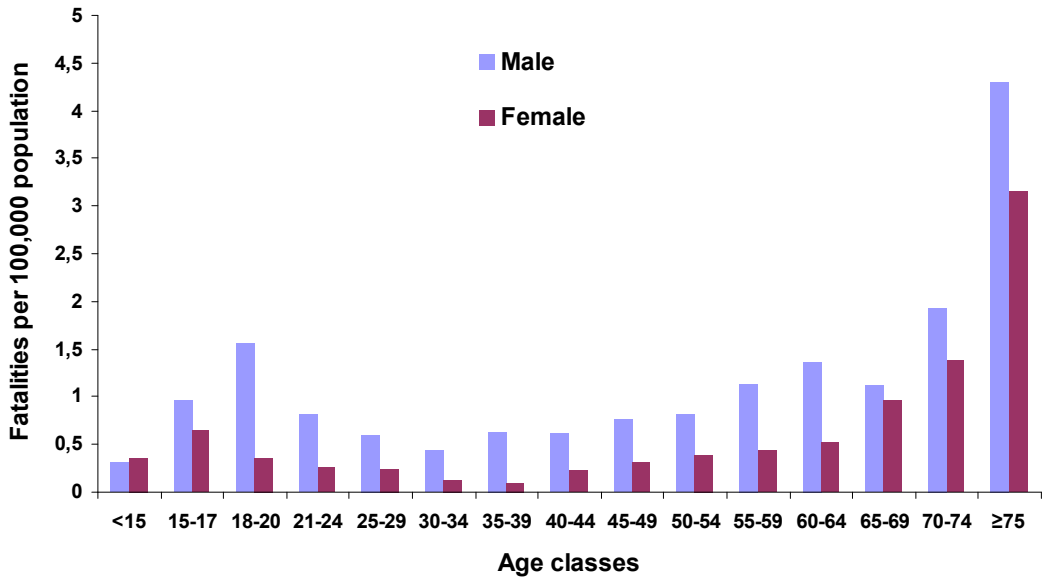


Figure 66: Pedestrian fatalities by age and sex per 100,000 population of each sex and age class, 2006 (Database: StBA, 2007)

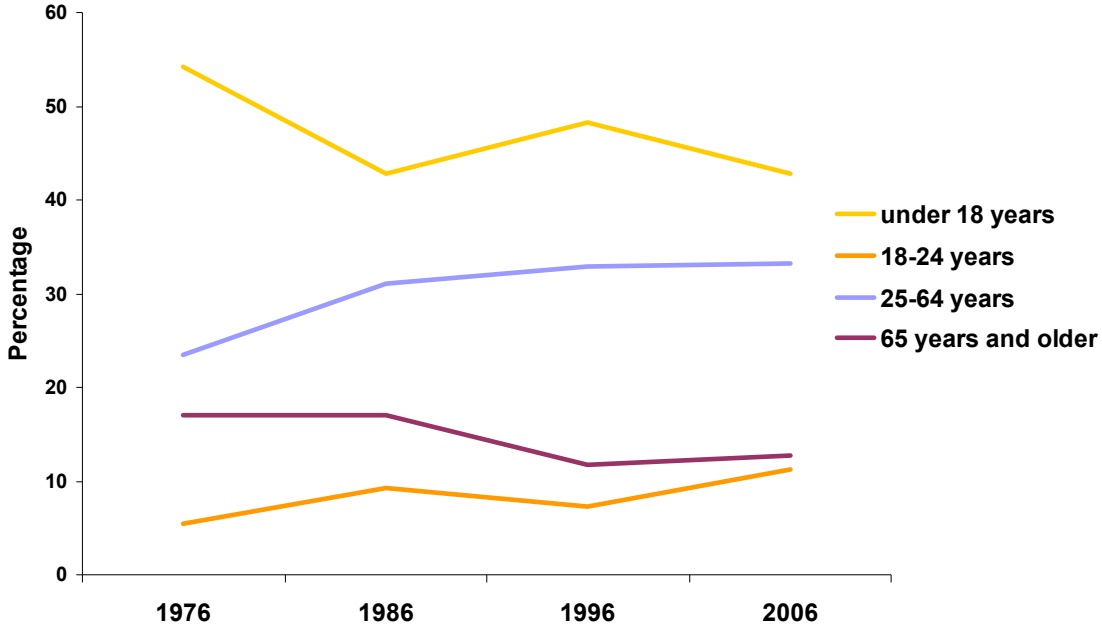


Figure 67: People primarily at fault as a percentage of all pedestrian crashes with bodily injury over time (Database: StBA, 1977-2007)

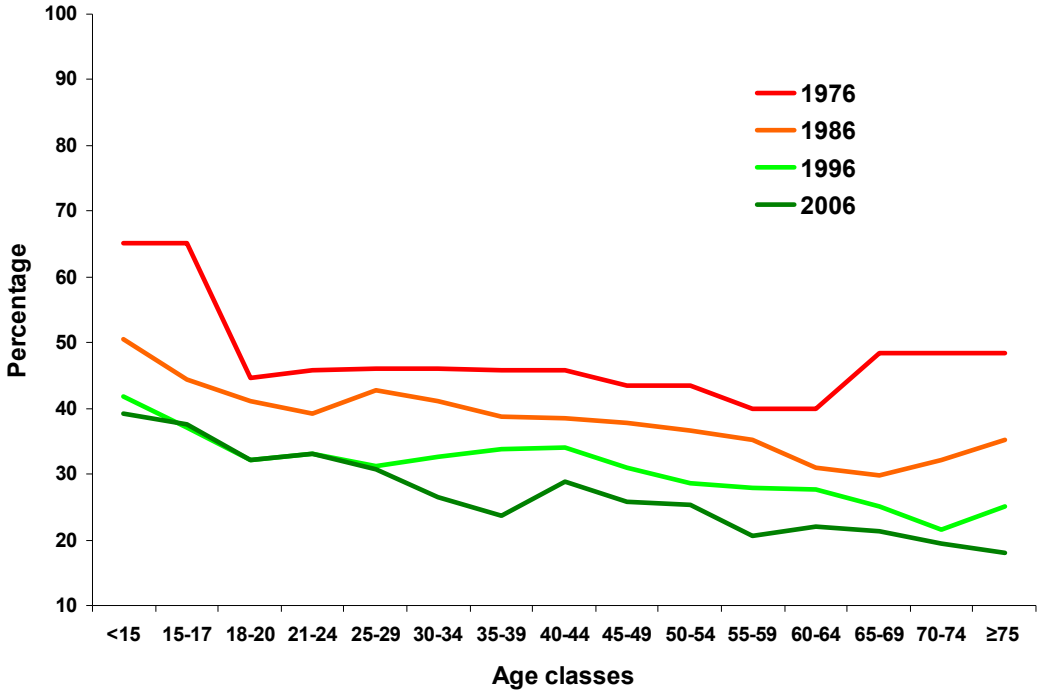


Figure 68: Pedestrian at-fault rates (at-faults per all pedestrians involved) by age over a 30-year period; the curve plateaus in 1976 are due to less detailed age classes (Database: StBA, 1977-2007)

The 30-year curve of the primary at-fault rate (ratio of people primarily at fault to everyone involved) clearly shows – in contrast to older car drivers – that the behavior of older pedestrians (as well as other age groups) has obviously improved over time (Figure 68). On the other hand, cohort effects must be reflected in the interpretation. For example, the "worse" 45-year-old pedestrians of 1976 are the "better" 75-year-olds of 2006. But the trend continues to show the clear relationship to age over the decades for pedestrians, as well. Older pedestrians tend not to be primarily at fault in crashes. But to explain this low at-fault rate for older people: It can be understood, among other things, by taking a closer look at one noteworthy characteristic factor for involvement in pedestrian crashes, which is the influence of alcohol. Accordingly, of 1,000 pedestrians involved in injury crashes, 44 are under the influence of alcohol (all age groups); among adults in the 18-55 age group, that number is between 94 and 83, for the young elderly it is only 28 and for the older elderly only 7 (no graphic).

The high mortality rate of older pedestrians continues to deserve particular attention when working to improve safety. Both passive measures (such as vehicle design) and active safety have not always taken the oldest pedestrians into account.

4.1.4 Older people and bicycle crashes

After pedestrians, bicyclists are the second main group of "weaker road users" who are at risk. Although this does not always appear to be the case from the viewpoint of pedestrians and drivers, since mistakes by bicyclists can lead to traffic offenses and result in fatal crashes, specially with pedestrians being the victims. However, how do things look for older cyclists?

Accident statistics clearly show that again it is above all the oldest bicyclists who lose their lives. Forty-eight percent of all bicyclists who are killed are 65 and older, and "only" 39 percent are in the 25-64 age group. Also, one-quarter are 75 and older. In contrast to pedestrians, fatal crashes involving older bicyclists tend to take place almost equally within (urban 56%) and outside of towns and cities (rural 44%), so strategies to improve the safety of older bicyclists should not be limited to collisions of right-turning car vs. bicycle which frequently occur in urban areas. Figure 69 shows the per-capita mortality rate over time. The phenomenon will be seen that safety is not stable from year to year. One may speculate as to the cause, but any explanation may not be used to justify the fact that the safety of older bicyclists, in contrast to that of middle-aged adults – suddenly improves and just as suddenly worsens, depending on campaigns, areas of emphasis, or the total annual hours of sunshine (for example in 2003).

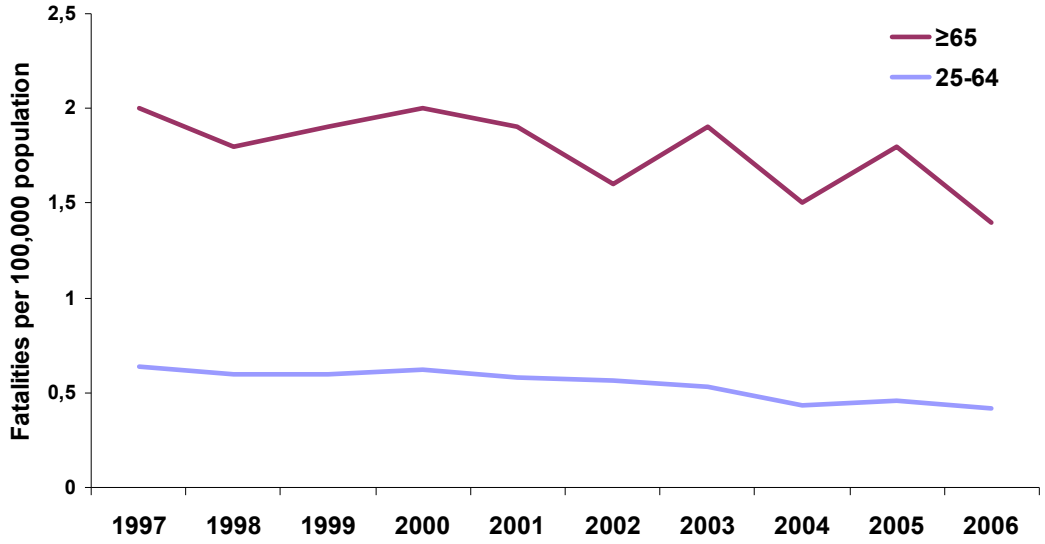


Figure 69: Bicycle fatalities per 100,000 population for two age classes over time (Database: StBA, 1998-2007)

There is a dramatic difference between the sexes. It is much more likely that an older man will be a victim (Figure 70). That unequal distribution very clearly corresponds to the availability of bicycles, according to MiD 2002. According to MiD, far more elderly men own a bicycle (66% of all older men) than do older women (44% of all older women). In contrast, the difference in all other 25-59 age classes is only a few percentage points. The difference between the sexes begins to increase at age 60. The conclusion seems obvious that specific leisure-related factors connected to the retirement age of men play a role in this.

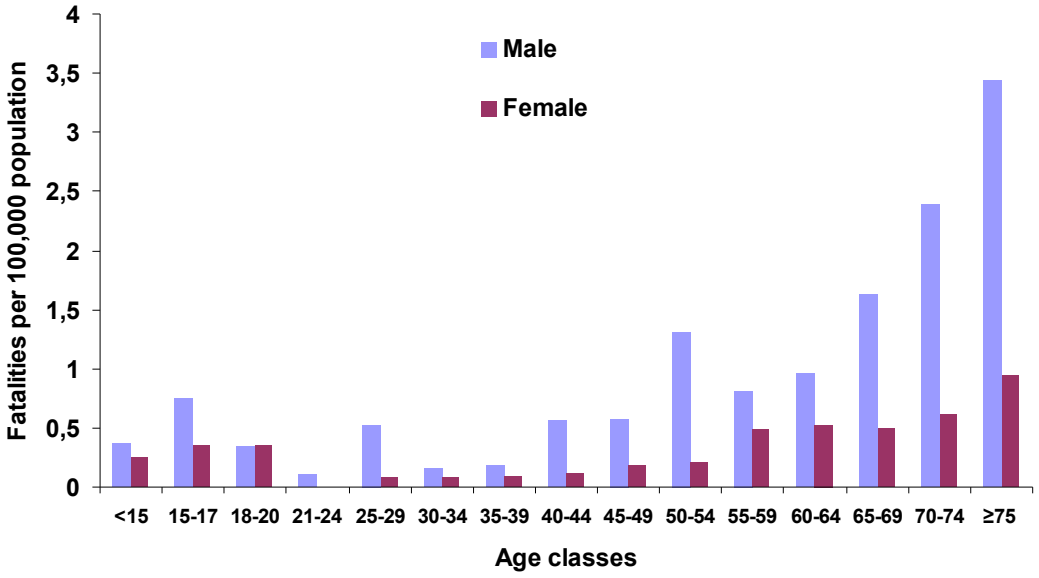


Figure 70: Bicycle fatalities by age and sex per 100,000 population of the sex and age class, 2006 (Database: StBA, 2007)

Finally, the following two graphs show the percentage of bicyclists who are primarily at fault in all accidents for the various age classes (Figure 71) and the at-fault rates (bicyclists who are primarily at fault to people involved in crashes) (Figure 72). Middle-aged adults will be seen to have steep increases in primary responsibility over time. The behavior of children and adolescents has improved markedly. There is only a slight increase for older people. The primary at-fault rate over time is also remarkable. There have been slight improvements for all age groups since 1976, and older people are coming closer to younger people; in contrast, the older elderly are still doing much worse and are at about the same level as adolescents in contributing to the bicycle crashes in which they are involved. Police statistics on errors by older bicyclists are roughly the same as those for older drivers (see Chapter 5 about the latter). Contrary to the 25-64 age group, turning and right-of-way errors take center stage

and alcohol is rarely a factor. The number of errors by bicyclists per 1,000 people involved in crashes constantly decreases with age, and it is not until ≥ age 75 that a slight increase for these oldest bicyclists returns them to the level of younger adults (Database: StBA, 2006).

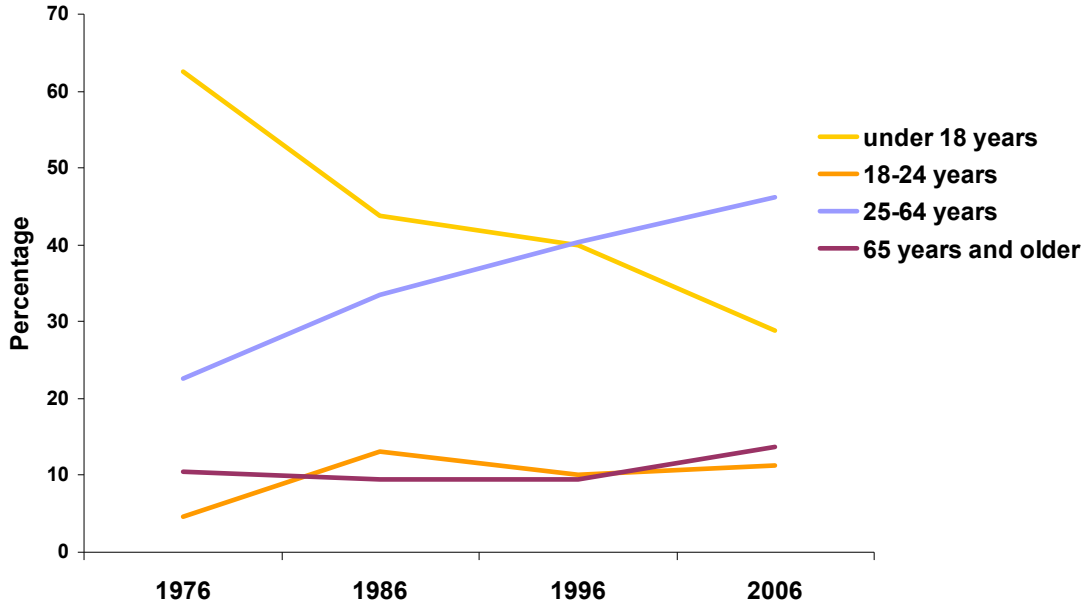


Figure 71: Percentage of bicyclists who are primarily at fault in all bicycle injury crashes over time (Database: StBA, 1977-2007)

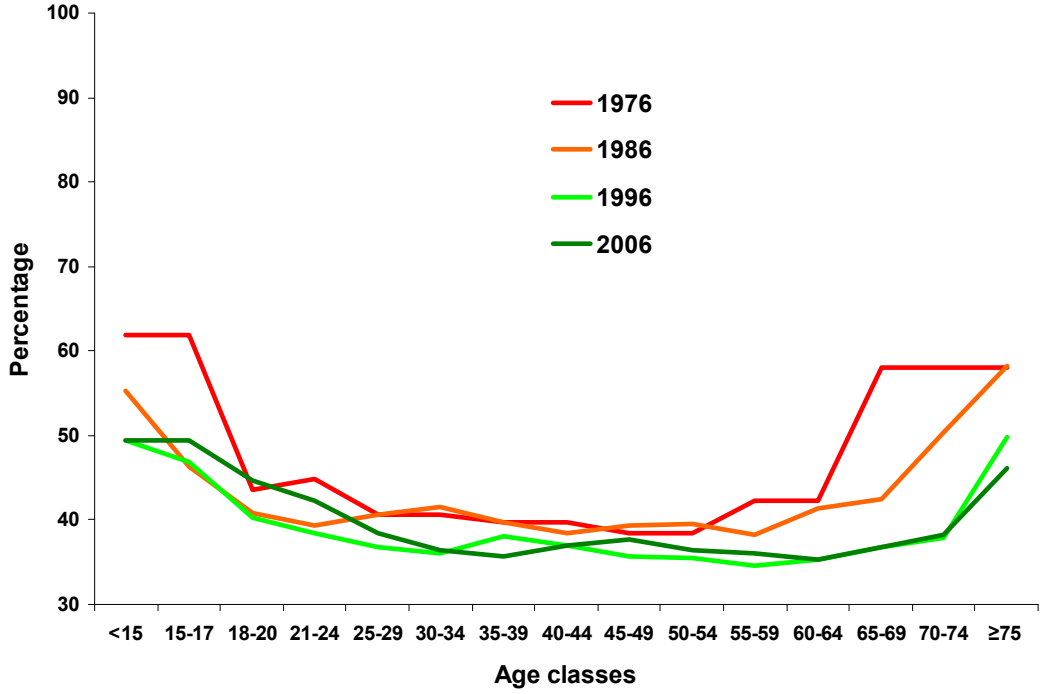


Figure 72: Primary at-fault rate (at-faults per all cyclists involved) of bicyclists by age over a 30-year period; the curve plateaus in 1976 due to broader age classes (Database: StBA, 1977-2007)

4.1.5 Crash involvement and fatalities in the German states

The discussion of the crash situation for Germany concludes with the distribution of the involvement rate of older people and the mortality rate for older people per 100,000 population in all of the German states (Figures 73 and 74)[9]. It has already been stated above that older people in Bavaria and Thuringia, as well as Schleswig-Holstein and other "northern states," are exposed to risks. This will presumably worsen through 2020 as the populations of the various German states continue to age (see Figure 14); this also applies to the state of Brandenburg, assuming that the very unfavorable projections for the future aging of the (suburban) areas around Berlin are accurate.

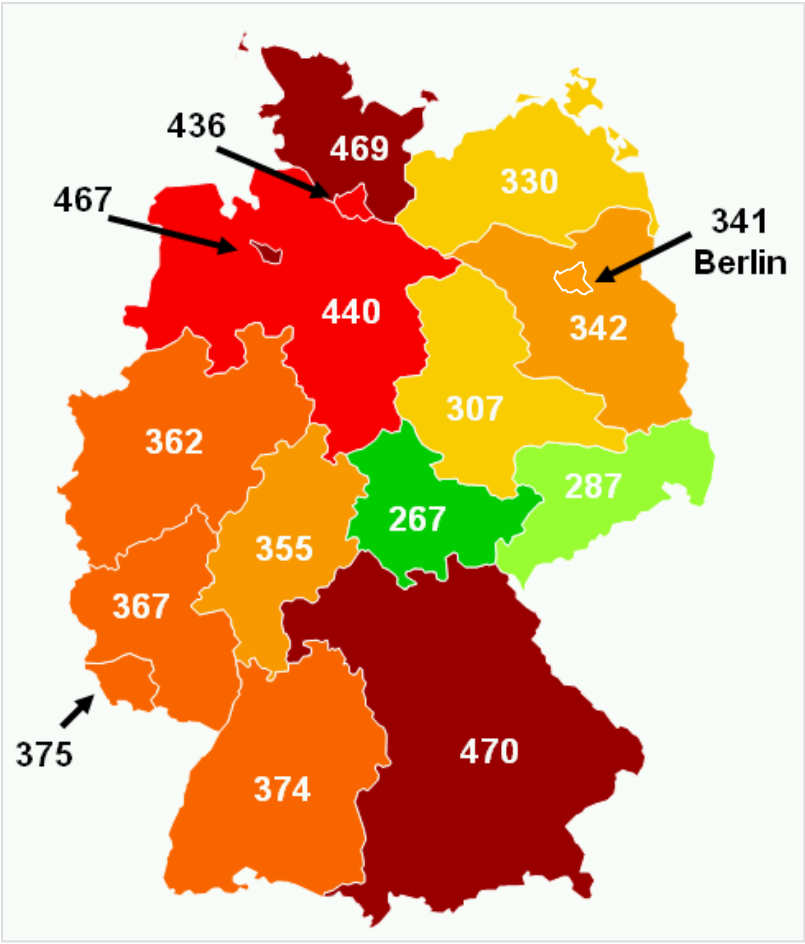


Figure 73: Rate of involvement of older people in injury crashes (per 100,000 population of the age class) in the German states, 2006 (Database: StBA, 2007)

[9] Note on Thuringia: The striking difference between a favorable involvement rate and an unfavorable mortality rate offers an opportunity to point out that the two rates need not move hand in hand. A low degree of involvement in crashes with bodily injury per 100,000 population in the age class for all types of road use does not exclude a high mortality rate in that age class. Given the lack of additional information, for example on the distances traveled by each age class for each transport mode, only assumptions can be made about the reasons for this difference.

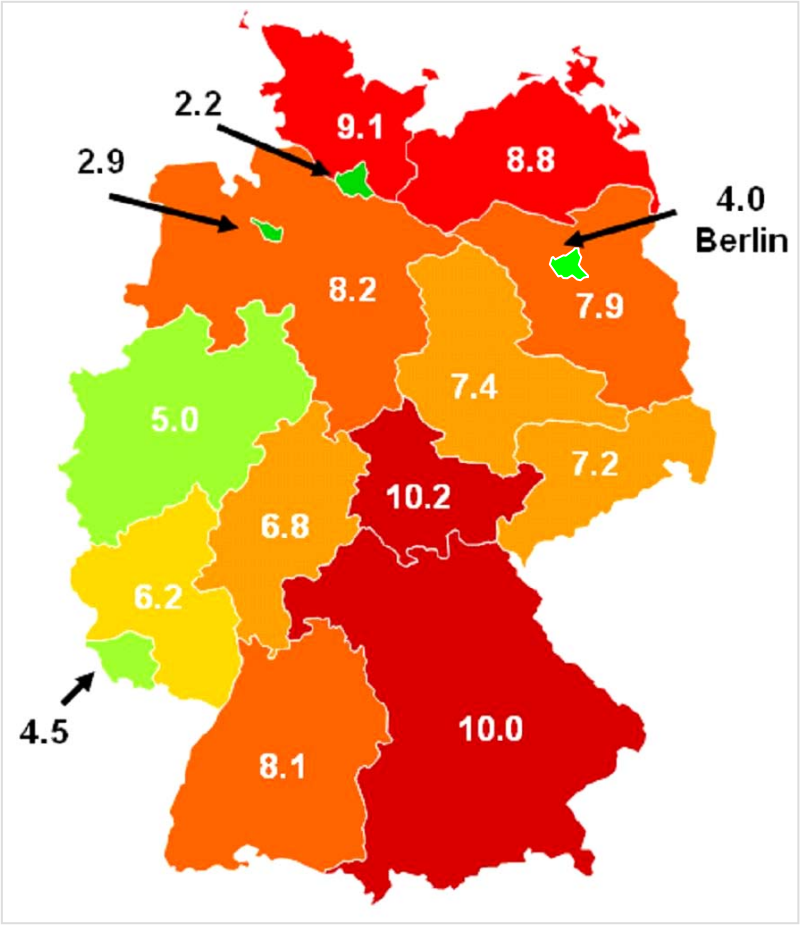


Figure 74: Fatality rate for older people (per 100,000 population of the age class) in the German federal states, 2006 (Database: StBA, 2007)

4.2 An overview of crashes in Europe

At least 8,260 older people were killed on the roads of the European Union (EU-27) in 2006. Although older people account for only one-sixth of the European population, more than every fifth road user who is killed is age 65 or older (37,800 people died on Europe's roads in 2006). This trend will be more pronounced in future due to demographic changes. Estimates indicate that every third accident victim will be an older road user in 2050 (see Figure 10).

The safety of older people compared with the remaining population

According to the EU average, the risk that an older road user will be killed is 16 percent higher than the risk for younger road users. However, the risk that older people face differs greatly among the Member States at the present time (Figure 75). In Lithuania, the risk that an older person will die in a traffic accident is almost four times higher than in Great Britain. The favorable rate for Malta should not be overestimated given its unusual geography.

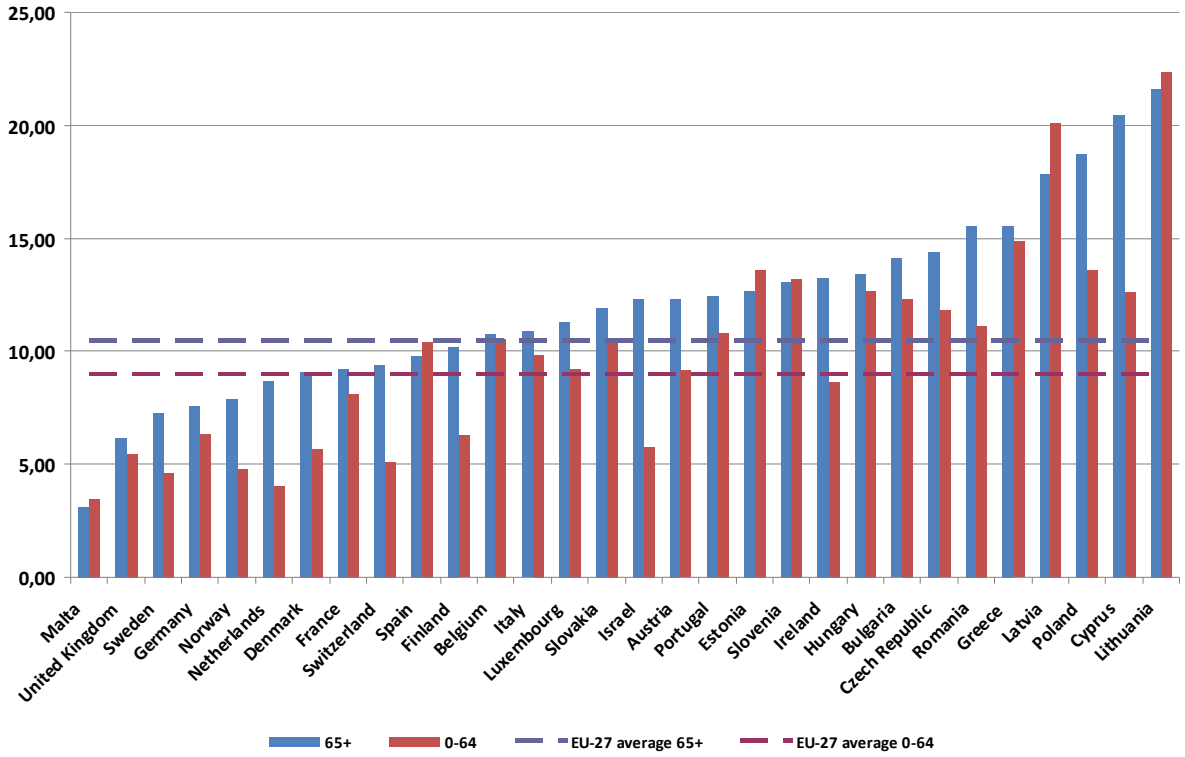


Figure 75: Mortality rate[10] for road users, age groups 0-64 years and 65 and over, average values for 2004, 2005, and 2006 (ETSC 2008a)

Some countries with a generally good road safety performance – such as the Netherlands, Sweden, Norway, and Finland – have relatively high mortality rates for older road users in relation to the rate for the remaining population (Figure 76). In particular, the risk that an older road user will die in the Netherlands and Switzerland is twice as high as it is for younger road users. Latvia, Malta, Estonia, Spain, Lithuania, and Slovenia have a lower mortality rate for older road users compared with the remaining population. Statistics strikingly show that in spite of existing standards, action is still needed to improve the safety of older people, although the absolute numbers of victims should not be forgotten when considering the ratios.

According to the findings of the traffic safety research institute SWOV, the high mortality rate for older road users in relation to the rate for the remaining population in the Netherlands could be attributable to the preferred choice of transport mode of older people who live there, because more older people in the Netherlands ride bicycles than in other EU States (ETSC 2008b). Moreover, older people in the Netherlands have a comparably high level of mobility due to good health and affluence (ibid.).

[10] Fatalities per 100,000 population

The Latvian Transport Ministry in fact considers the low level of mobility among older people there to be a possible reason for the low ratio (ibid.). If older people in that Baltic country are less affluent than the younger people there, that could limit their mobility.

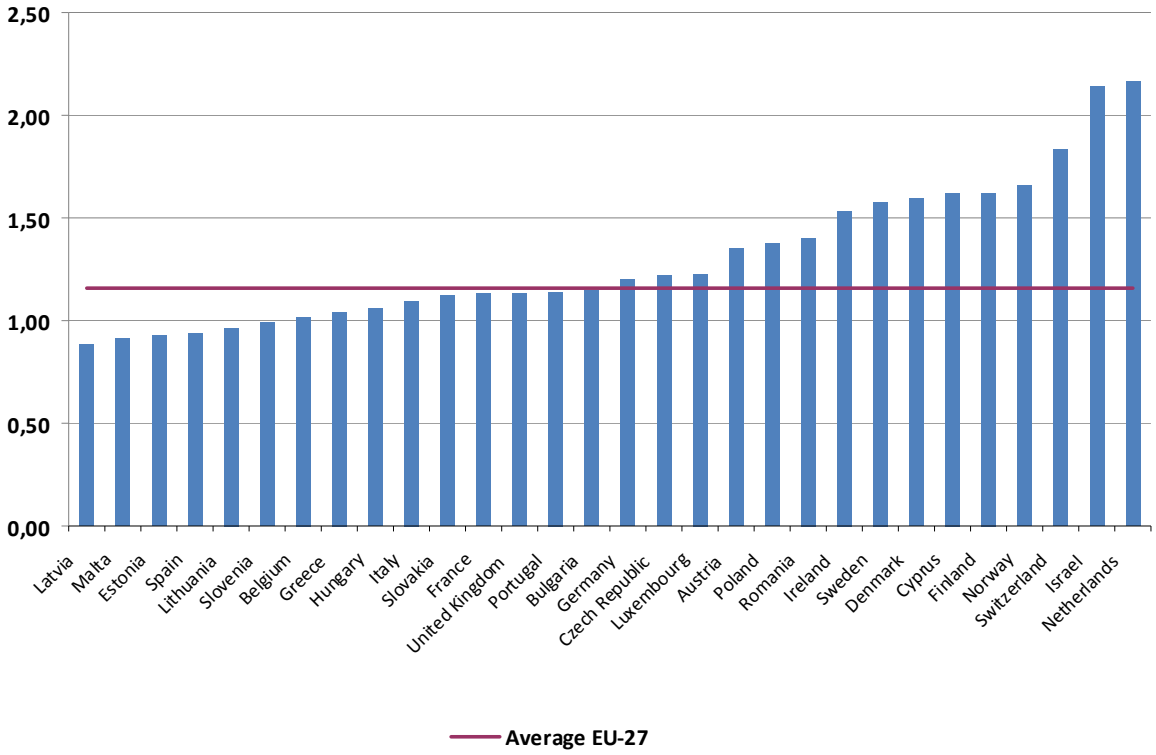
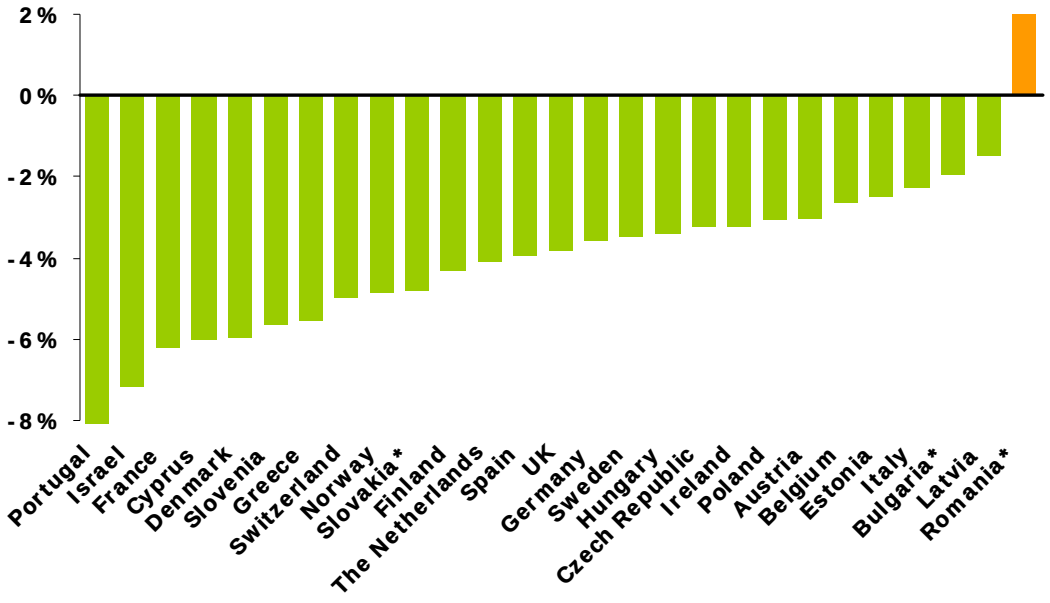


Figure 76: Ratio (quotient) of the mortality rate for older people to the mortality rate for the remaining population. Averages for 2004, 2005, and 2006 (ETSC, 2008a)

Trend for the safety of older road users

Over the last decade, Portugal has reduced road fatalities in older people by eight percent, making the greatest progress in improving the safety of older road users in the European Union (Figure 77).

France, Cyprus, and Denmark have also been able to reduce fatalities of older road users by six percent annually. Slovenia, Greece, Switzerland, Norway, Slovakia, Finland, the Netherlands, and Spain follow the aforementioned group, achieving reductions which were above the EU average of 3.9 percent. Bulgaria and Latvia have made the slowest progress in the last ten years, less than two percent annually. The situation has worsened in Romania, with annual increases of 2 percent in mortality rates.



*Slovakia (2003-2006), Bulgaria (2001-2006), Romania (2000-2006)

Figure 77: Average annual change in mortality rates for older people in traffic accidents, 1997-2006 (ETSC, 2008a)

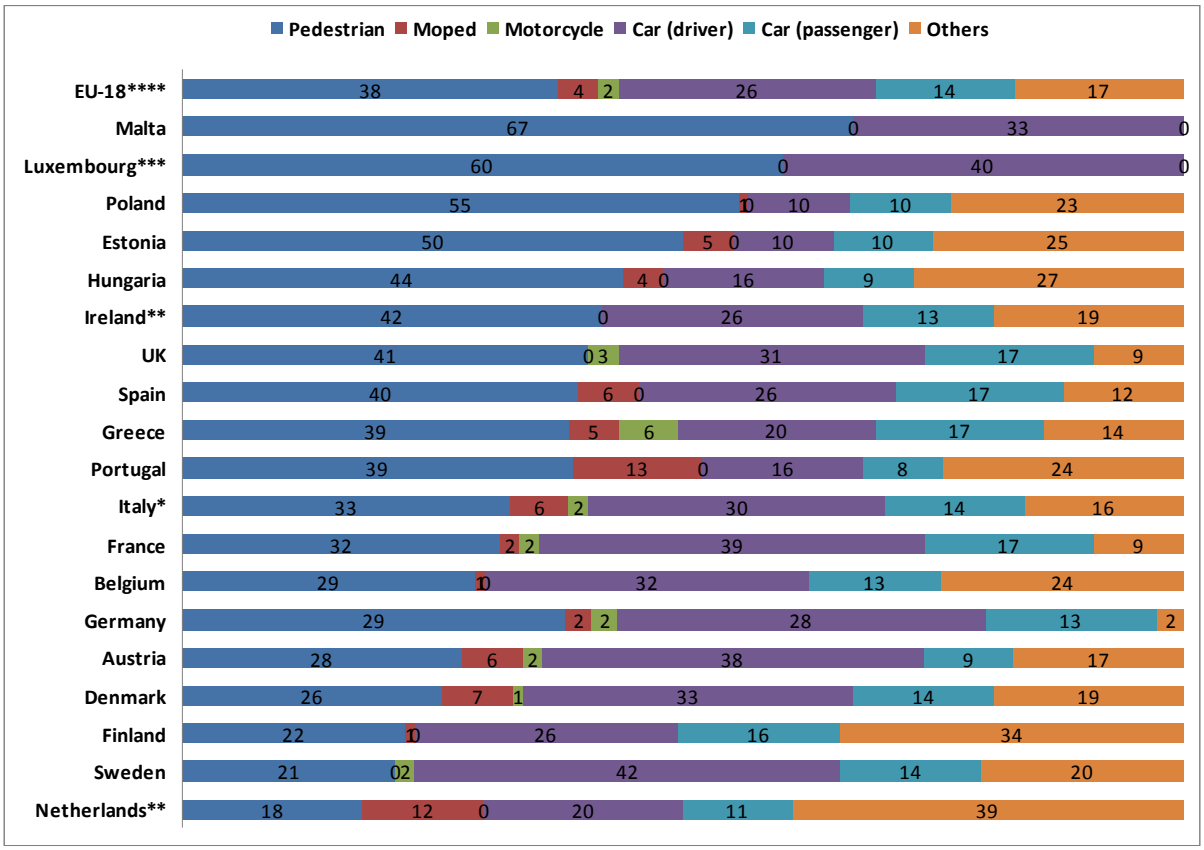
Fatalities among older road users by transport mode

Figure 78 shows the distribution of fatalities within the group of older users by transport mode. Approximately 37.5 percent of the people who died were pedestrians. The percentage of older pedestrians in Estonia, Malta, Hungary, and Poland is particularly high. The percentage of fatalities among older drivers ranges from ten percent in Poland to approximately 40 percent in France, Sweden, and Austria.

As is the case in Germany, most older road users who are killed are occupants of cars (car driver or passenger) or pedestrians (see above for bicyclists). The data on the EU-19, with some figures updated for 2006, which was published by EPSO after this report does not change this picture very much, although there has been a slight shift in favor of pedestrian safety and to the detriment of other transport modes.

Figure 79 (p. 85) shows that most fatalities among road users are men. Approximately two-thirds of all people involved in fatal crashes in the EU-18 are men. Among older fatalities in Belgium, Denmark, Germany, France, Great Britain, Ireland, Luxembourg,[11] and Poland, more than 40 percent are women.

[11] Not significant due to low number of cases



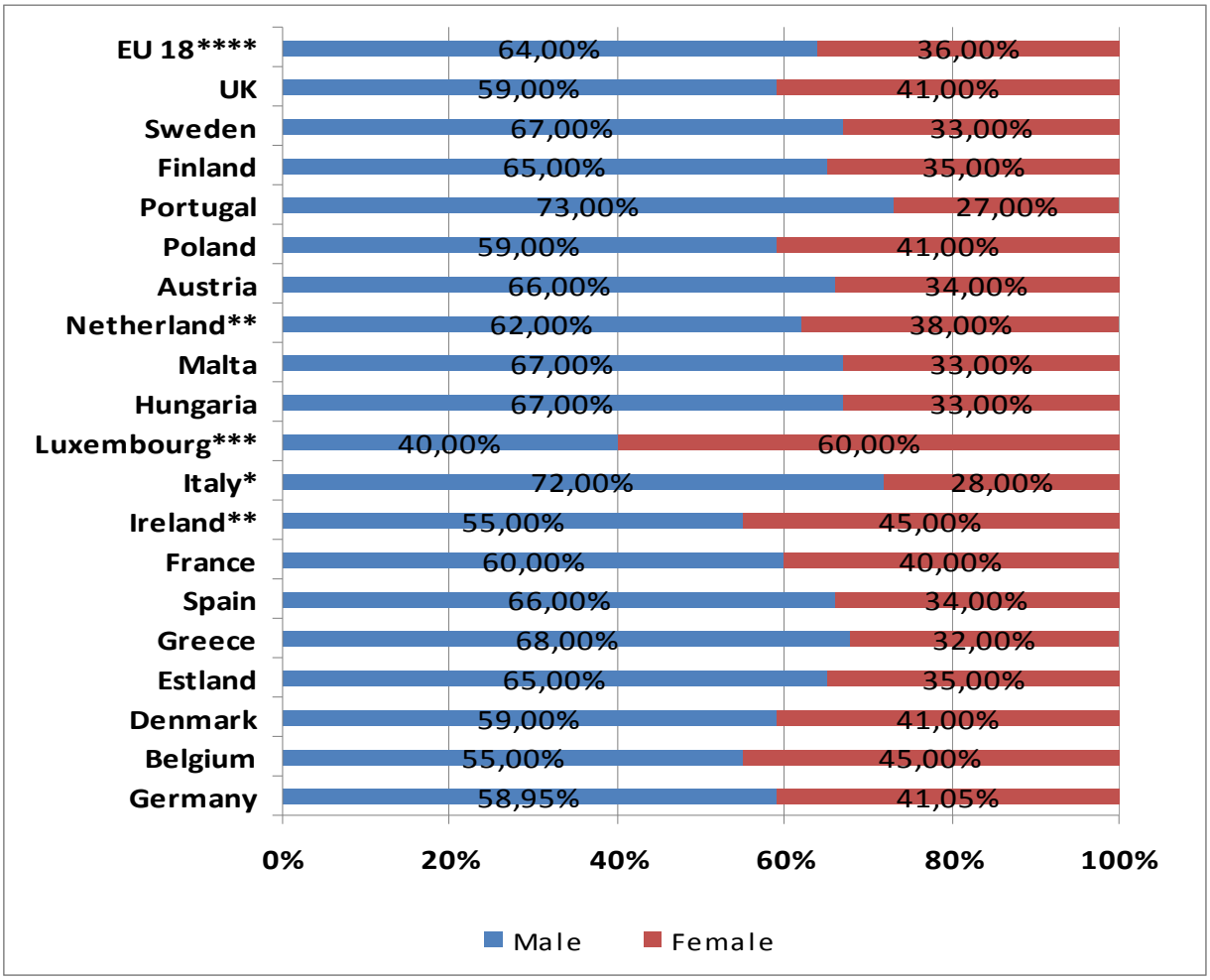
* 2004, ** 2003, *** 2002, **** All countries except Germany

Figure 78: Percentage of fatalities among older people in 2005 by type of road use (transport mode) in the EU 18 plus Germany (Germany: "Others" without bicyclists) (ERSO, 2007a, for EU-18; German Federal Statistical Office, Fachserie 8, Reihe 7, 2005, for Germany)

Percentage of older road user fatalities out of all road user fatalities

Figure 80 (p. 86) shows older road user fatalities as a percentage of all road user fatalities (in other words, all age groups) by type of road use (transport mode). The distributions reflect the limited mobility and greater vulnerability of older people. In the EU-18, approximately 40 percent of all pedestrian fatalities are seniors; that value is lowest in Estonia, Poland, and Hungary (see below on the situation for bicyclists).

The situation is similar in Germany (Figure 81, p. 86). Forty-nine percent of all pedestrians who were killed were over age 65 during the reference year for the above EU data. Overall, 22 percent of the fatalities were among older people (see section 4.1).



* 2004, ** 2003, *** 2002, **** All countries except Germany

Figure 79: Percentage fatalities of older road users in the EU-18 plus Germany by sex, 2005 (ERSO, 2007a, for the EU-18; German Federal Statistical Office, Series 8, Volume 7, 2005, für Deutschland)

Excursion: Older pedestrians in Europe

Older people still make up the largest group among pedestrian fatalities in the European Community – ERSO data for EU-14 can presented here – although the number of older pedestrian fatalities between 1996 and 2005 in the EU-14 declined from 2,476 to 1,450 (-41.4%) (Figure 82, p. 87). The number of all pedestrian fatalities decreased by 36.8 percent during the same period. But one must keep in mind that EU-14 does exclude a varied kind of countries with high pedestrian accident figures.

Figure 83 (p. 87) shows the percentage of pedestrian fatalities in different age groups available for EU-18. The large percentage of older pedestrian fatalities is striking, as is the number of fatalities among children.

	Pedestrian	Moped	Motorcycle	Car (driver)	Car (passenger)	Other	Total
Belgium	50	7	0	13	16	22	17
Denmark	41	17	6	19	21	18	21
Estonia	22	50	0	4	7	16	12
Greece	54	28	5	12	18	30	19
Spain	42	14	0	12	15	15	16
France	51	5	2	18	20	24	19
Ireland**	34	(-)	0	13	11	23	16
Italy*	54	18	3	19	17	29	21
Luxembourg***	50	(-)	(-)	5	0	0	8
Hungary	31	23	1	9	8	24	16
Malta	33	(-)	0	50	0	0	18
Netherlands**	40	29	0	13	18	33	21
Austria	44	22	3	17	13	26	20
Poland	29	23	3	7	9	22	17
Portugal	40	27	0	12	10	21	18
Finland	44	25	0	15	22	46	24
Sweden	44	0	4	23	19	33	24
UK	36	4	3	16	18	19	18
EU-18	40	15	2	14	15	20	18

* 2004, ** 2003, *** 2002

Figure 80: Older road user fatalities as a percentage of all road user fatalities by transport mode in the EU-18 (ERSO, 2007a)

	Pedestrian	Bicycle	Car driver	Motorcycle	Motorized bike	Moped	Total
Germany	49	49	17	2	33	18	22

Figure 81: Older road user fatalities as a percentage of all road user fatalities by transport mode in Germany (German Federal Statistical Office, Fachserie 8, Reihe 7, 2005)

One reason being discussed for this is the low degree of car ownership in those age groups. Moreover, as is the case for older people, the vulnerability of children is greater than it is in the group of young adults. Based on the mortality rate for pedestrians (fatalities per one million population), the rate for older pedestrians is also much higher than for the other age groups and increases sharply as older people age (Figure 84, p. 88). Future safety efforts will have to focus on this type of road use with emphasis, particularly in countries with considerable increases in the number of older people in the population.

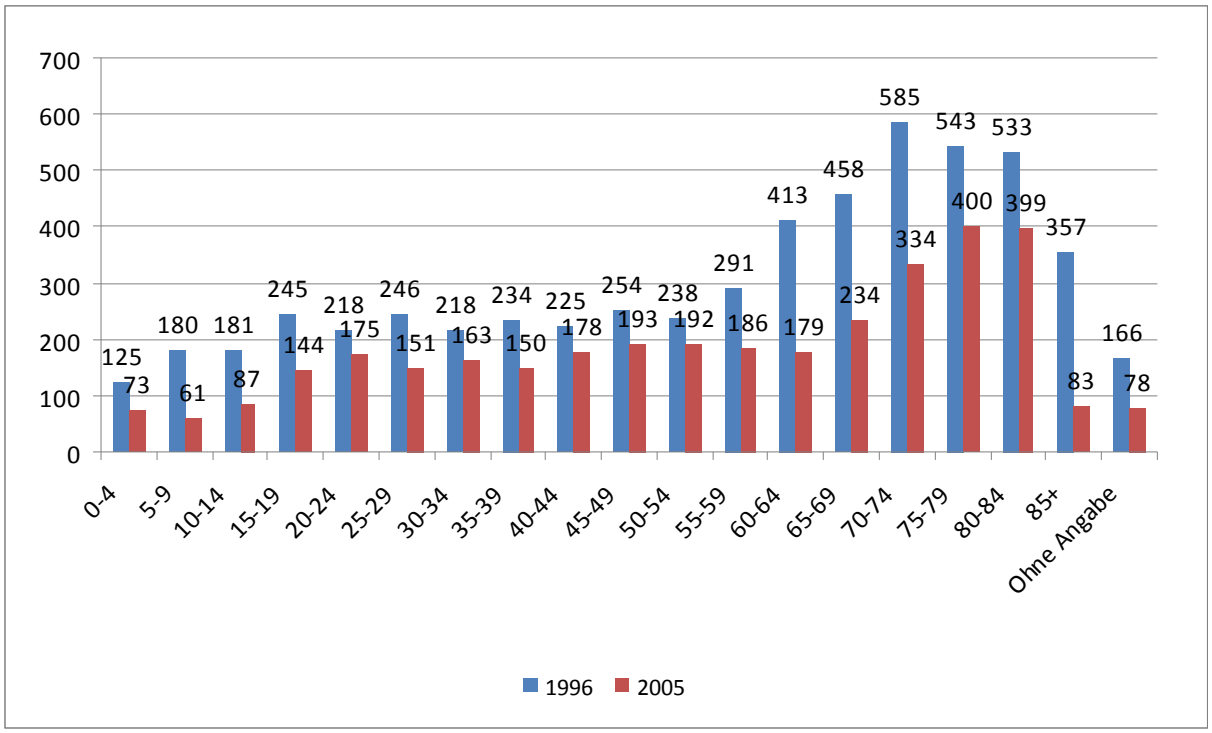


Figure 82: Pedestrian fatalities in the EU-14 by age group, 1996 and 2005 (Ohne Angabe/No Information (ERSO, 2007b)

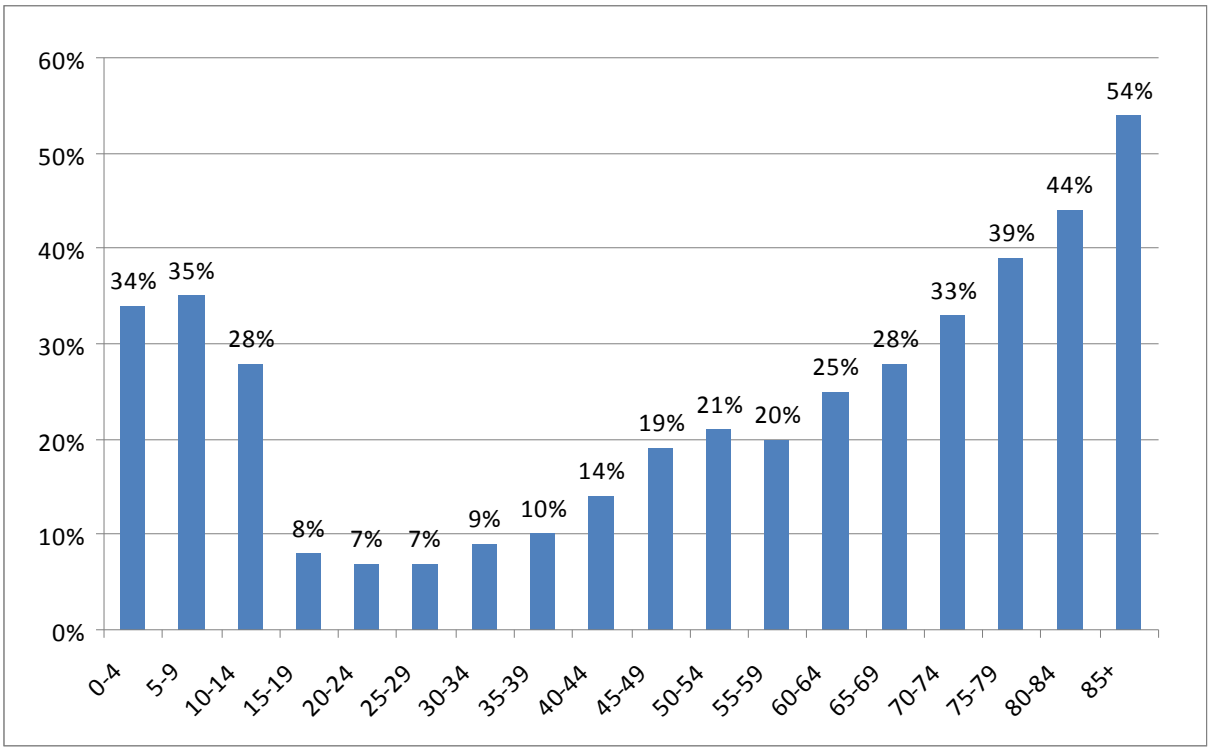


Figure 83: Older pedestrian fatalities as a percentage of all road user fatalities in the EU-18 by age group, 2005 (ERSO 2007b)

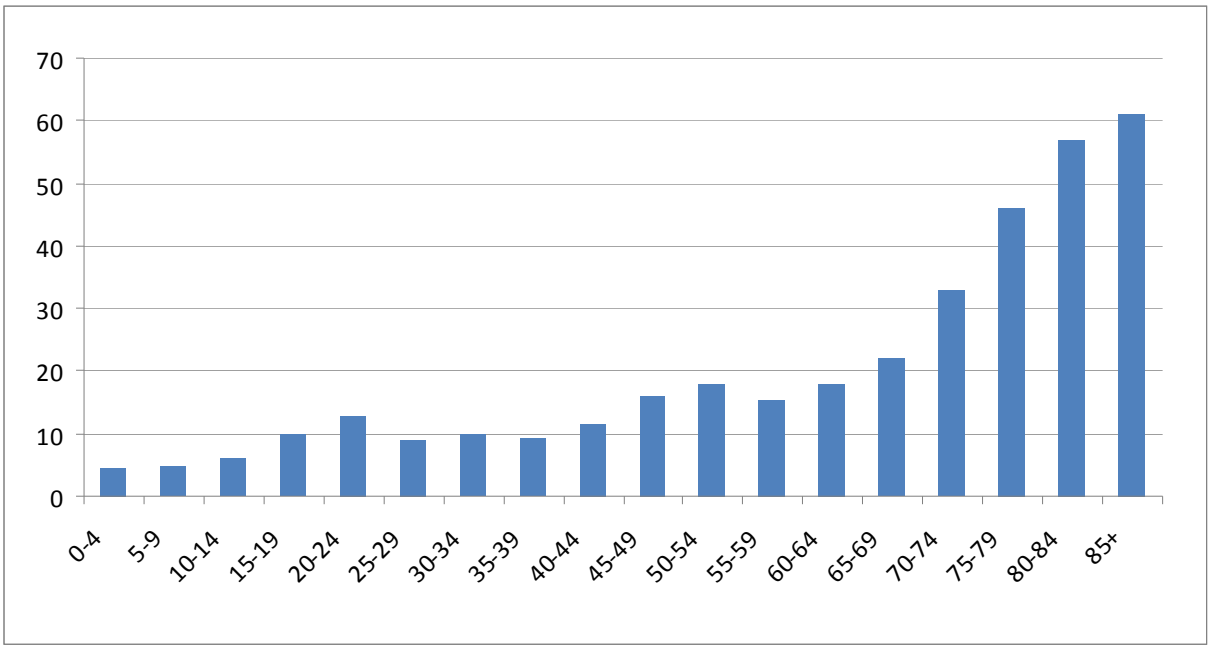


Figure 84: Pedestrian fatalities per 1 million population in the EU-18 by age group, 2005 (ERSO, 2007b)

Excursion: Older bicyclists in Europe

Due to differences in the treatment of official crash data, the unfortunate truth is that not all information that would be useful for efforts to improve safety can be shown uniformly for the entire European Union. That has previously been the case for crash statistics on bicyclists. Within the context of an analysis of accidents involving older people, the EU Traffic Accident Causation in Europe project (TRACE, 2007) of the European Commission did a special evaluation for six selected European countries, including Germany (in-depth databases for France, Germany, Great Britain, Italy, Spain, and the Czech Republic between 2001 and 2004). The data shows that the situation is worse for older people when age groups are compared. Figure 85 shows the percentage distribution of road fatalities according to the type of road use. The percentage of older bicyclists is about 2.5 times higher than it is for younger people.

The most recent data analyses of the CARE database which have been published (ERSO, 2008) do not include all EU Member States, either (EU-14 and 19); but they give a sufficient impression of the distribution of bicycle fatalities over the age classes. According to the analyses, 44 percent of all bicyclists who died were over age 60 (ERSO, 2008).

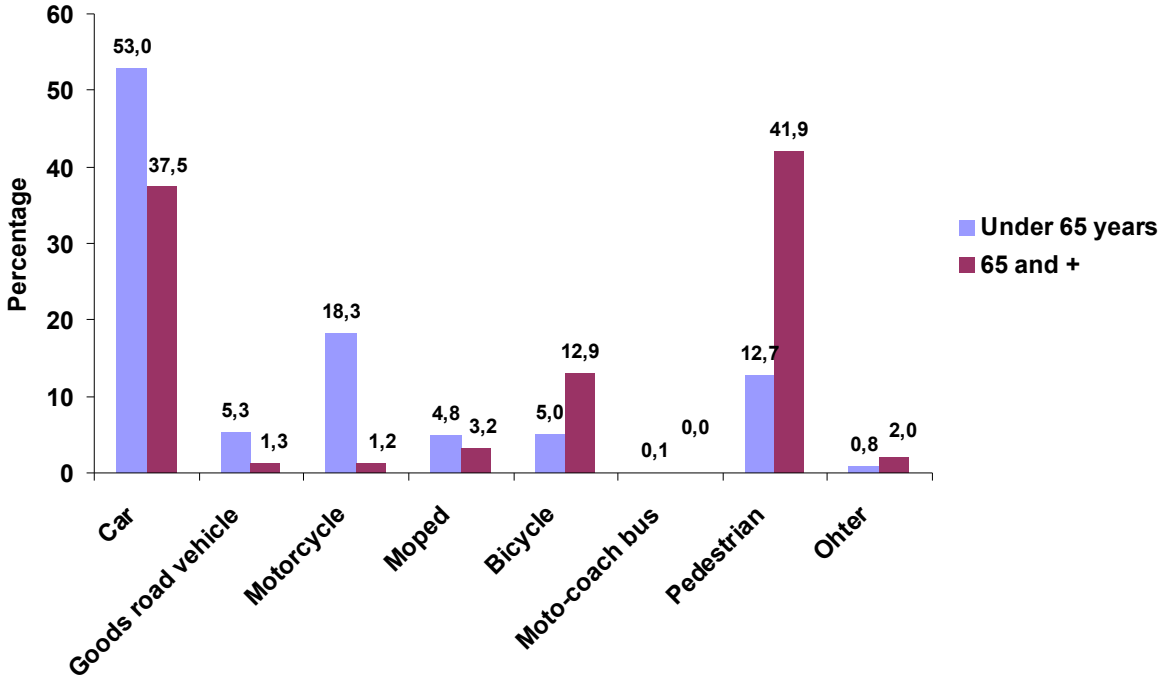


Figure 85: Percentage of road fatalities by mode of road use according to special evaluation of selected EU Member States (FR, DE, UK, IT, ES, CZ), data between 2001 and 2004 (TRACE, 2007)

Similar to the German data, the distribution peaks for schoolchildren and older people were generally clear, although the absolute number of fatalities constantly increases from the beginning of the fifth decade of age (Figure 86). The crash rate is reported to be 7 (per one million population) for 15-year-olds and 20 for 85-year-olds (ERSO, 2008) (no graphic). The trend between 1997 and 2006 also shows that the bicycle as transport mode in the EU tends to be getting safer for everyone, but to a greater extent for young people. Data for all EU-19 Member States (between 2002 and 2006) which can not be presented here in detail, clearly shows – again in accordance with German figures – that men who ride bicycles are at greater risk than women and that men often die more than twice as often. The findings on bicycle safety are also surprisingly independent of national attributes (such as region, economy, or size of country).

Non-age-based EU data shows that the risk to bicyclists in all countries tends to be on sections that do not include intersections, where nearly two-thirds (61 %) of all fatalities occur, and that "only" a good one-third (37 %) occur at intersections (or junctions). But when comparing all modes of road use, the intersection is most hazardous for bicycles, with the above 37 percent at the top, followed by mopeds (32.7 % at intersections); pedestrians are listed with

22, cars with 16 percent. The average is 20 percent for all modes of road use. This means that intersections are more dangerous for bicyclists than they are for other modes of road use, although the majority of bicycle accidents occur elsewhere (ERSO, 2008, based on EU-18 data 2005). In that respect, older people are the primary victims of bicycle crashes, but it is still obvious that those responsible for road planning, road construction, and the elimination of accident "black spots" at intersections must pay close attention to the skills and weaknesses of older people – they are meant when cyclists' safety is at issue.

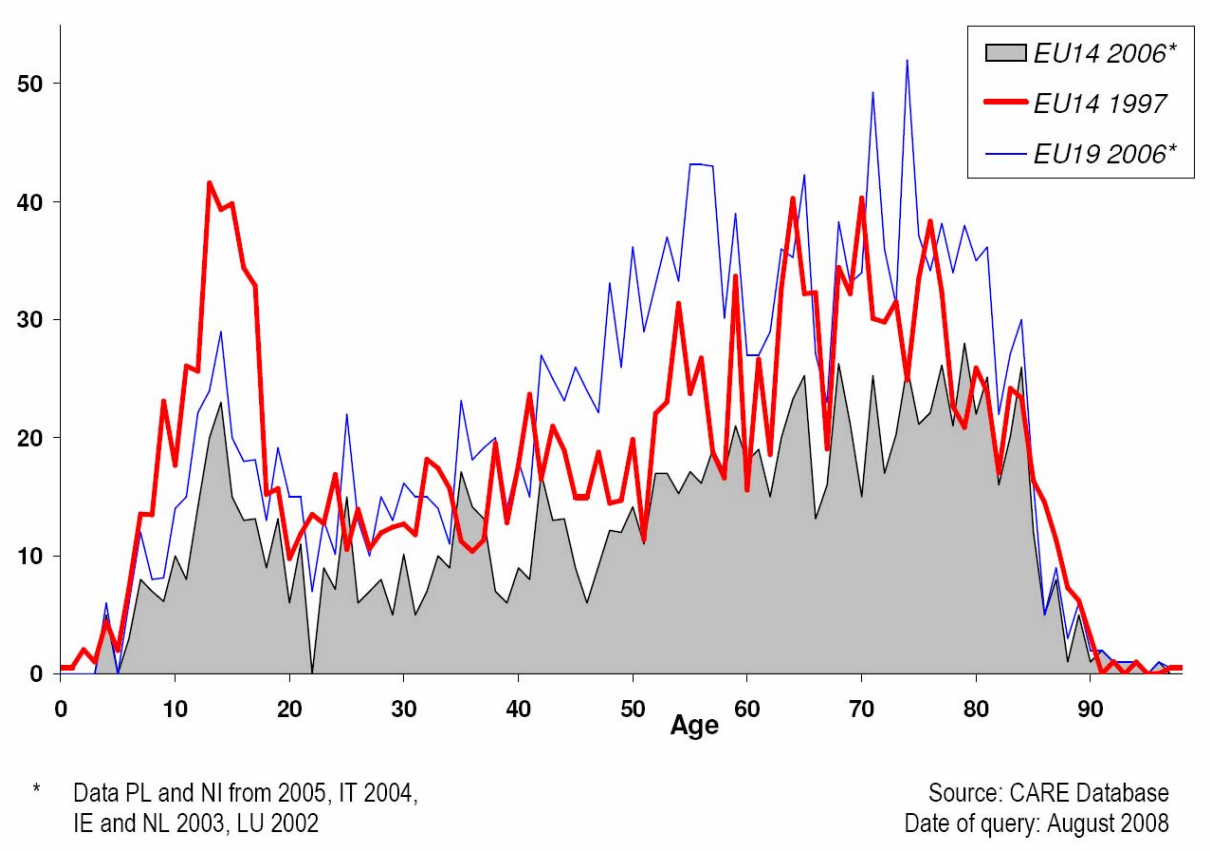
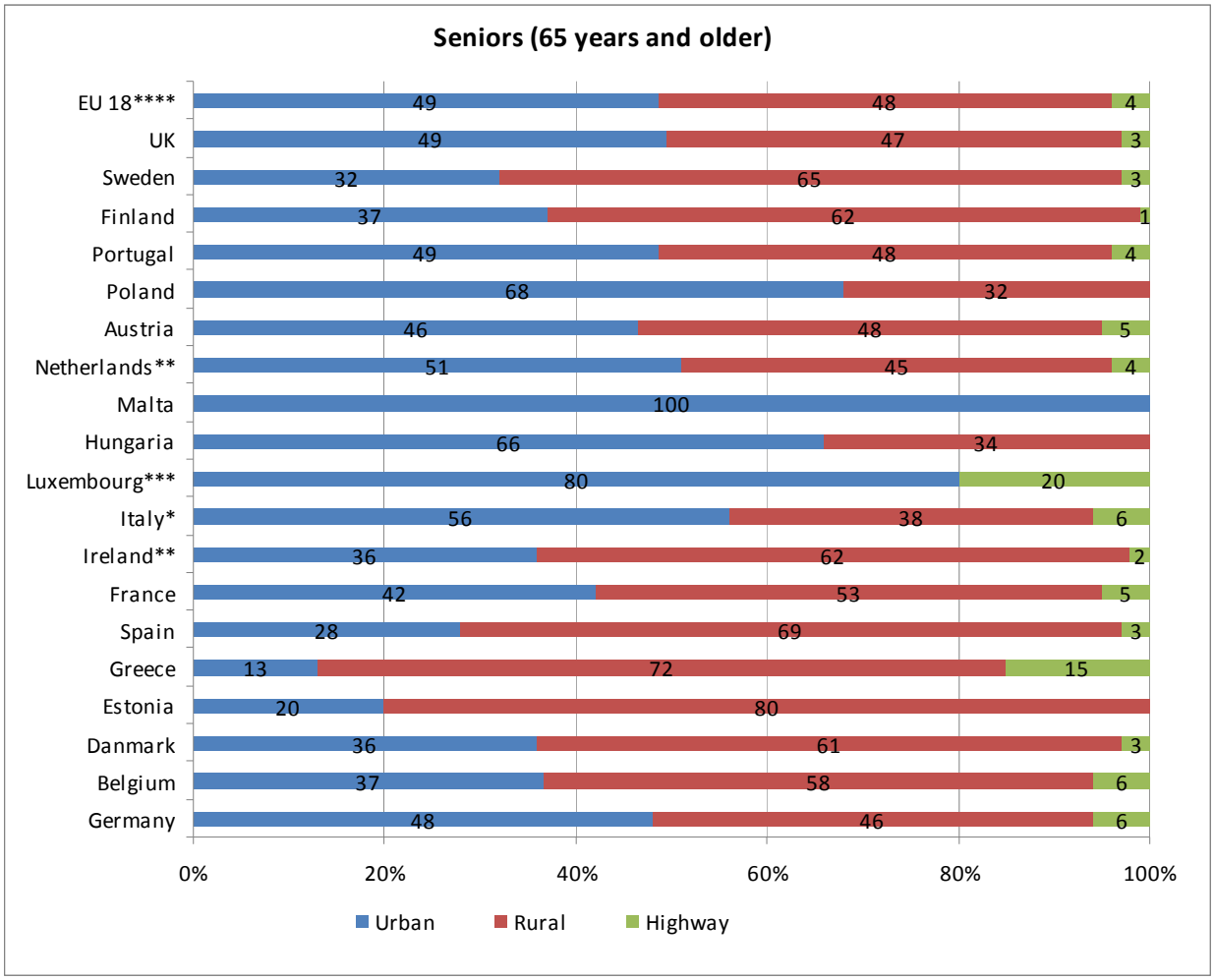


Figure 86: Absolute numbers of bicycle fatalities in selected EU Member States (EU-14 und EU-19) by age class (ERSO, 2008; graphic cited according to ERSO, 2008)

Overall, these considerations do not paint a positive picture of the use of bicycles by older people. Notwithstanding the positive safety trend (for all age groups), this is one of the most dangerous transport mode for older people aside from walking. Safety efforts at the European level must focus on this more strongly than has previously been the case. To improve the safety of older bicyclists, it is not sufficient to improve the general safety of all bicyclists, because older people always benefit less from general measures than younger people do.

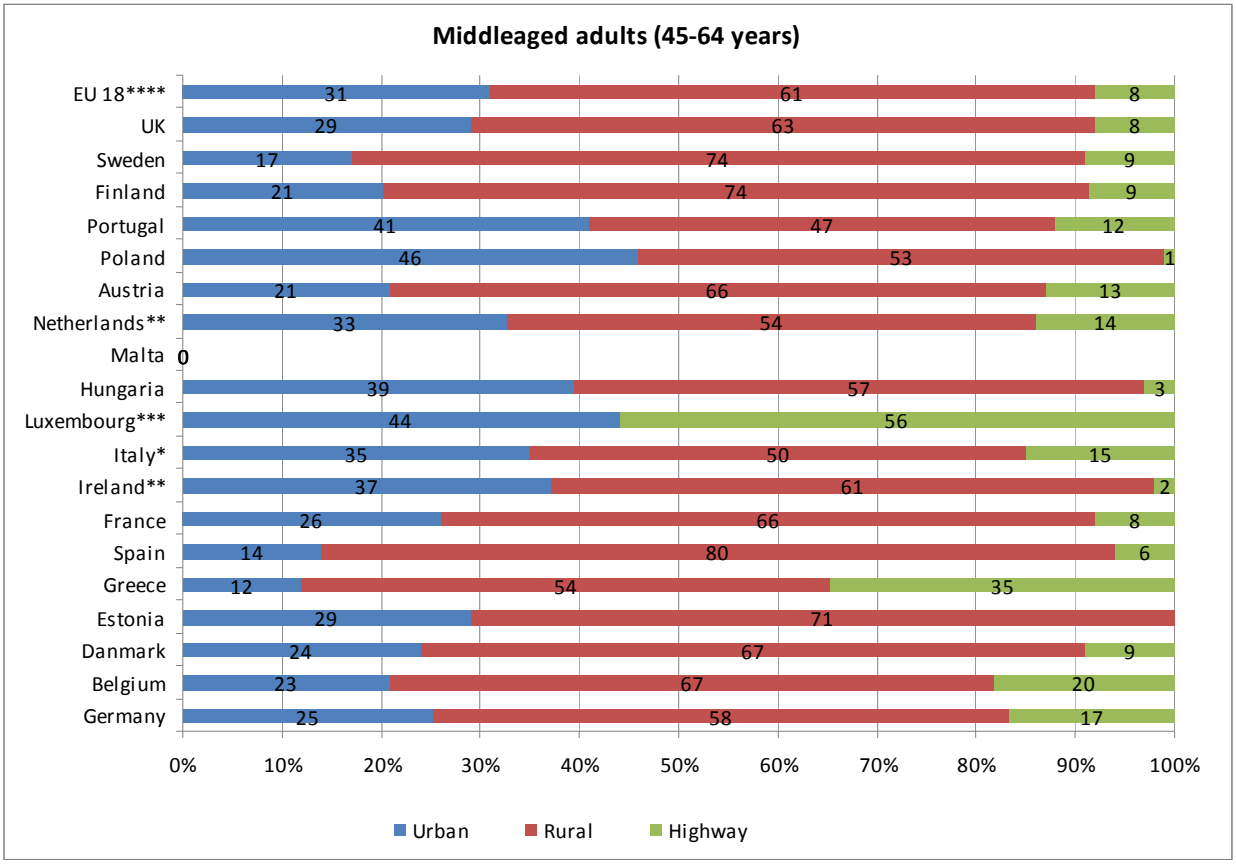
Casualties by location

Figures 87 and 88 show the distribution of fatalities among older people according to type of road (urban, rural, highway), compared with the distribution for middle-aged adults (45-64 age group). The graphics show that rural roads are somewhat more hazardous for middle-aged adults than urban roads. There is a slight tendency for the reverse to be the case for older people, but the data shows that both types of location are relevant to safety throughout the EU. The outliers in those graphics (such as Malta) should not be overestimated due to their particular geography. This EU data unfortunately does not allow more in-depth analyses (for example according to type of road by mode of road use). But the problem related to older pedestrians and bicyclists which was identified above for Germany fundamentally applies to other countries, as well. Thus, older people throughout Europe tend to die during the day in dry weather more than younger people do (TRACE, 2007).



* 2004, ** 2003, *** 2002, **** All countries except Germany

Figure 87: Distribution of road traffic fatalities for the senior age group by type of road (urban, rural, highway) (ERSO, 2007a)



*2004, ** 2003, *** 2002, **** All countries except Germany

Figure 88: Distribution of road traffic fatalities for the 45-64 year group by type of road (urban, rural, highway) (ERSO, 2007a)

The fact that the percentage of casualties among older people is lower on freeways and highways than it is for younger people, while the percentage of casualties among older people is greater in urban areas than that it is for the younger group, can be explained among other things by the more limited mobility of older people and the high percentage of foot traffic in their modal split (ERSO, 2007). Overall, the distributions vary considerably depending on the country concerned.

Summary – The pattern of crashes involving older people in Europe

Although the data varies greatly among Member States, a clear conclusion can be drawn concerning the safety of older people. As in Germany and without denying the risk for senior car drivers, older road users, who are said to be "weaker" and are at least passive (passenger), are particularly at risk. To summarize, it should be noted that every fifth person who is killed on the road in the EU is over age 65, although elderly people make up only one-sixth of the

European population. The crash risk of an older person varies considerably among the Member States, although all EU States except Romania have been able to reduce the mortality rates of older people during the last decade. In the EU as a whole, most fatalities among older people are pedestrians, although most older people lose their lives as drivers in some countries, such as Sweden, France, and Austria. In some countries (Greece, France, Italy), over 50 percent of pedestrian fatalities are older people. In contrast to middle-aged adults (45-65), most older people die in cities and towns. The data shows that there is still a clear need for action to improve the safety of older people. At the same time, there is a considerable need for research: The fluctuation range in national data can be explained by geographic, sociological, legislative, infrastructure-related, and economic factors. None of the previous European studies has been able to determine detailed target measures for all Member States. The political focus of the EU White Paper, which was fewer fatalities on Europe's roads, cannot be achieved solely through trans-regional and international developments and instead will require local and national thinking that in turn is methodically linked and pooled at the EU level.

4.3 Knowledge from the insurance business

Other sources besides the data collected by the police or other officials can be used to document accident statistics. One of the most important is the number of claims submitted to the providers of automobile liability insurance. This cannot be directly compared to official road crash statistics, although specific aspects and topics, such as the structure of the most serious crashes, are fundamentally similar. However, there are differences, due among other things to the fact that not all collisions that are reported to insurers are recorded by the police. That is primarily the case for collisions involving property damage only. They make up the majority of claims that are adjusted. As required by law, the German Federal Statistical Office and the state statistical offices record only crashes with bodily injury and crashes with major property damage (meaning that at least one vehicle had to be towed). The aspect of public order and the state's duty to ensure the common welfare becomes clear. Insurers adjust all claims, including those involving minor property damage. Their claims databases come closer to showing the population of all vehicle collisions, for example with regard to the aspect of the collision structure of a specific driver or group of drivers, even if that population is not always relevant for road traffic safety (for example, due to the many claims related to parking and

maneuvering vehicles). In that respect, insurers' data primarily differs with regard to the distribution of crashes by location, showing more crashes in urban areas. Notwithstanding this and other limitations, contrasting insurers' data with official data may offer greater insight into the structure and origins of crashes, since more in-depth information is available in many cases.

It has already been stated that, for the reasons described above, German insurers have different knowledge about the age distribution of traffic crashes. At-fault accidents involving older drivers certainly do not always have results that are as favorable as those described in section 4.1. A series of international studies has also explored this. A good illustration gives the assessment done by the Insurance Institute for Highway Safety (IIHS, cited with Monash University, 2006) in the United States. Figure 89 shows that the age-related increase in the claims rate (claims per 100,000 vehicles) rises clearly at around age 75. The "inverted bell curve" of the distribution was more obvious for older drivers, particularly the oldest elderly, than in a series of curves showing crashes based on German crash statistics. But older drivers still looked better than the youngest group of drivers.

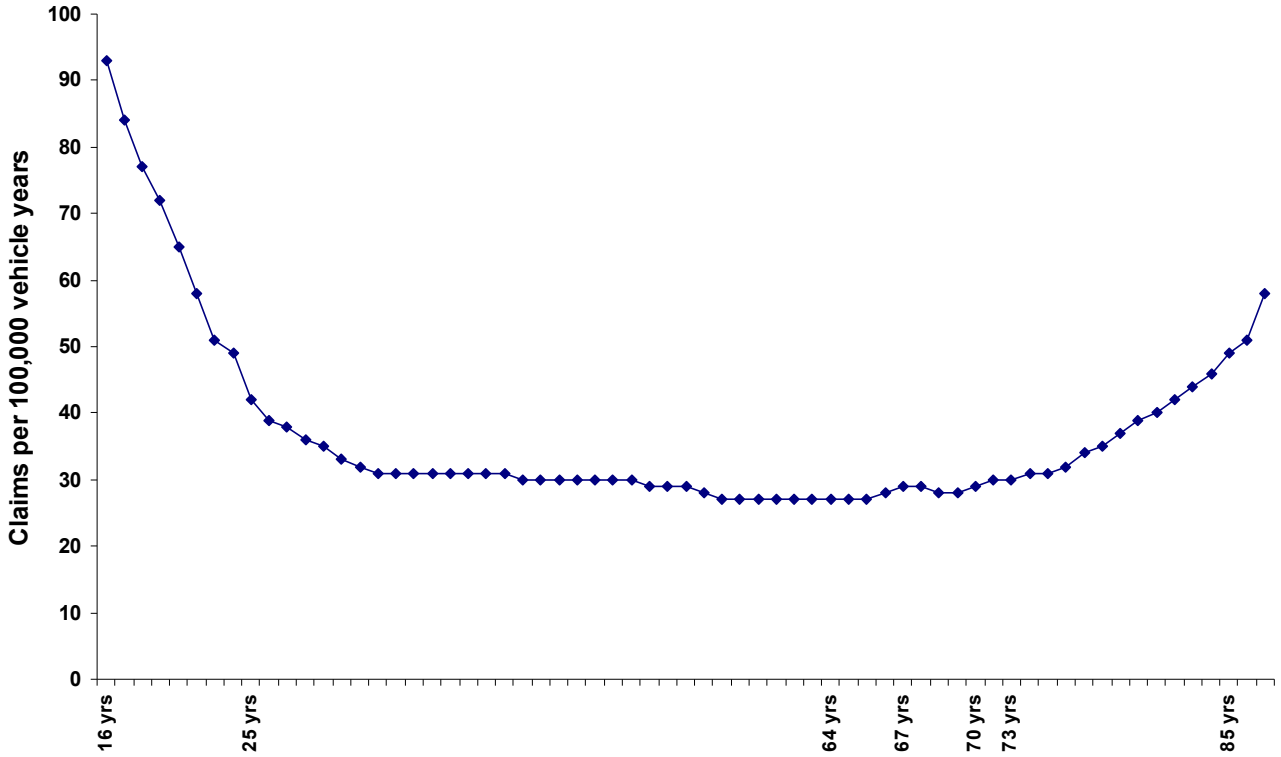


Figure 89: Insurance claims per 100,000 insured vehicle years by age of the driver (IIHS, cited according to Monash University, 2006)

The following analysis of accident files from Allianz Versicherungs-AG, which was done by AZT Automotive GmbH – Allianz Zentrum für Technik, is based on a total of approximately 2,700 automobile liability claims which had already been considered in other research that has been presented to the public and have now been separately evaluated by age classes. N=1,731 files of injury crashes and N=1,000 files of property crashes (with no minimum damage limit) were selected from 2004 claims of the (former) Bayerische Allianz and analyzed by age class. The random samples showed a distribution with more crashes in urban areas than the official data of the Bavarian State Statistical Office, aside from that they were sufficiently comparable.

Crash characteristics by age

Accidents with casualties

The random sample contained N=1,002 files that included information on the age of the driver (the policyholder was the identified at-fault driver). The distribution correlates very well with the percentage of drivers who were primarily at fault in all car crashes with bodily injury in 2004 according to German federal statistics: 12.7% (Federation 10.5%) seniors, 64.5% (Federation 62%) middle-aged, 22.9% (Federation 27.5%) young drivers. Figure 90 shows (with the exception of N) the percentages for selected features, each of which is based on the partial random samples for the age group (646 and 127 = 100 percent each).

There are many similarities between crashes involving older people and younger people. For few features only, known from the literature, this data show senior drivers different in their accidents: Seniors were at fault more frequent in crashes at T-junctions, they were less in wet weather. Chapter 5 will discuss age-specific aspects of traffic accidents in detail. The smaller percentage of crashes at night with street lighting is also in accordance with the research, whereas the uniform distribution of crashes in the dark (without street lighting) is unusual.

	Age 25-64		**Age 65+**	
	Absolute number	**%**	**Absolute number**	**%**
N	646	(64.5)	127	(12.7)
Casualties	794	123	152	120
• **Fatalities**	7	1.1	2	1.6
• **Major injuries**	49	7.6	9	7.1
• **Minor injuries**	738	114.2	141	111.0

	Age 25-64		Age 65+	
	Absolute number	%	Absolute number	%
Sex of driver				
• Male	418	64.7	79	62.2
• Female	227	35.1	48	37.8
• Not registered	1	0.2	0	0
Location				
• Urban	470	72.8	96	75.6
• Rural	111	17.2	19	15
• Highway	36	5.6	3	2.4
• Not specified	29	4.5	9	7.1
Light conditions				
• Day	489	75.7	103	81.1
• Night	77	11.9	15	11.8
• Night with PSL[12]	59	9.1	6	4.7
• Not specified	21	3.3	3	2.4
Road surface				
• Dry	249	38.5	42	33.1
• Wet	110	17.0	13	10.2
• Icy	34	5.3	3	2.4
• Other	1	0.2	0	0
• Not specified	252	39.0	69	54.3
Collision with				
• Car	449	69.5	90	70.9
• Truck	16	2.5	2	1.6
• Motorized cycle	59	9.1	7	5.5
• Bicycle	85	13.2	17	13.4
• Pedestrian	24	3.7	9	7.1
• Single-vehicle crash	10	1.5	2	1.6
• Other	2	0.3	0	0
• Not specified	0	0	0	0
Crash site				
• Straight section	180	27.9	30	23.6
• Curve	31	4.8	4	3.1
• T-junction	97	15.0	30	23.6
• Intersection	204	31.6	40	31.5
• Traffic circle	5	0.8	1	0.8
• Driveway from private property	38	5.9	9	7.1
• Other	11	1.7	1	0.8
• Not specified	0	0	12	9.4

Figure 90: Distribution of crash characteristics in the Allianz random sample of injury crashes in 2004 by age

[12] Permanent street lighting

Figure 91 offers an overview of the distribution of crash characteristics for the various older age classes within the seniors (total N was 1002, ≥ 65 N was 127). In addition to the comparison between "young elderly" (65-74) and "older elderly" (≥ 75), the ≥ 80 group was also considered, since 27 such cases were available and could provide some insight into this group of the oldest drivers.

The data on older age classes shows that the T-junction is a situation that increasingly involves the risk of a crash as drivers age. In contrast, four-way intersections seem to be less of a concern here. However, it must be kept in mind that the case study being presented here recorded all intersection areas as a "crash site in the road system" and that most of them were located within cities and thus were predominantly controlled by traffic lights or rules on rights-of-way.

Beside this, the statistics on crashes involving the older elderly group were comparable with those for the younger elderly and for middle-aged adults. Figure 92 shows the percentage of crash sites at T-junctions in relation to the respective random sample size of the age classes. Figure 93 illustrates the plausibility of the Allianz data based on the results of the European Union AGILE project (2001).

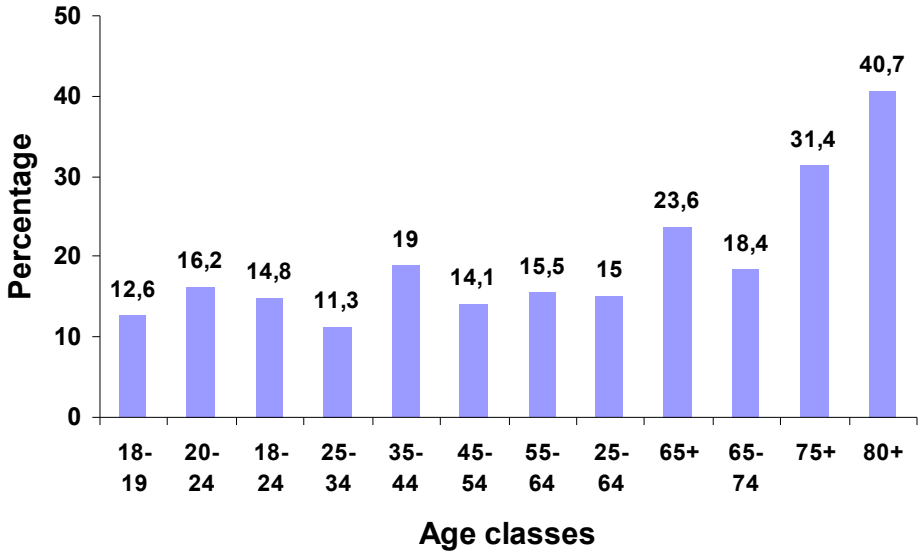


Figure 92: T-junction crash sites as a percentage of all crashes for each age class, injury accidents, in 2004 Allianz claim data

	Age 65-74		Age 75+		Age 80+	
	Absolute number	%	Absolute number	%	Absolute number	%
N	76	(7.6)	51	(5.1)	27	(2.7)
Casualties	91	119.7	61	119.6	31	114.8
• **Fatalities**	1	1.3	1	2.0	0	0
• **Major injuries**	4	5.3	5	9.8	2	7.4
• **Minor injuries**	86	113.2	55	107.8	29	107.4
Sex of driver						
• **Male**	48	63.2	31	60.8	17	63.0
• **Female**	28	36.8	20	39.2	10	37.0
Location						
• **Urban**	56	73.7	40	78.4	22	81.5
• **Rural**	13	17.1	6	11.8	4	14.8
• **Freeway**	2	2.6	1	2.0	0	0
• **Not specified**	5	6.6	4	7.8	1	3.7
Light conditions						
• **Day**	60	78.9	43	84.3	23	85.2
• **Night**	8	10.5	7	13.7	4	14.8
• **Night with PSL**	5	6.6	1	2.0	0	0
• **Not specified**	3	3.9	0	0	0	0
Road surface						
• **Dry**	22	28.9	20	39.2	11	40.7
• **Wet**	8	10.5	5	9.8	2	7.4
• **Icy**	2	2.6	1	2.0	0	0
• **Other**	0	0	0	0	0	0
• **Not specified**	44	57.9	25	49.0	14	51.9
Collision with						
• **Car**	55	72.4	35	68.6	20	74.1
• **Truck**	2	2.6	0	0	0	0
• **Motorized cycle**	4	5.3	3	5.9	2	7.4
• **Bicycle**	6	7.9	11	21.6	5	18.5
• **Pedestrian**	7	9.2	2	3.9	0	0
• **Single-vehicle crash**	2	2.6	0	0	0	0
• **Other**	0	0	0	0	0	0
Crash site						
• **Straight section**	17	22.4	13	25.5	5	18.5
• **Curve**	2	2.6	2	3.9	1	3.7
• **T-junction**	14	18.4	16	31.4	11	40.7
• **Intersection**	26	34.2	14	27.5	7	25.9
• **Traffic circle**	1	1.3	0	0	0	0
• **Driveway from private property**	5	6.6	4	7.8	2	7.4
• **Other**	1	1.3	0	0	0	0
• **Not specified**	10	13.2	2	3.9	1	3.7

Figure 91: Distribution of crash characteristics in the Allianz random sample of injury crashes in 2004 for various older age classes within the senior group

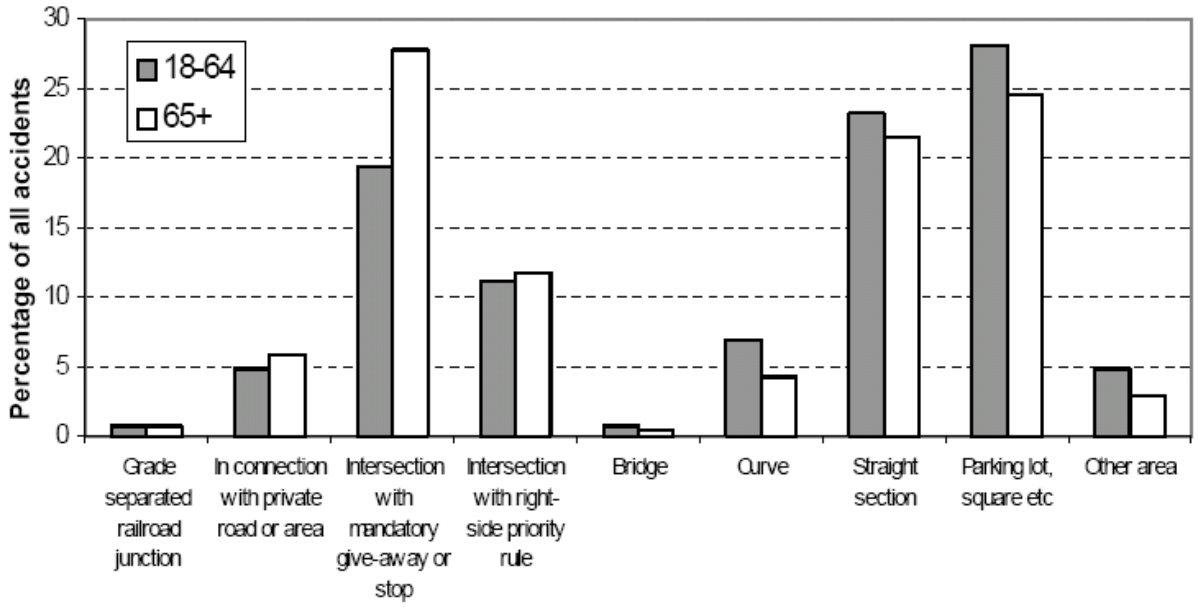


Figure 93: Crash distribution as a percentage by crash site and age (Finland, 1991-1995) (AGILE, 2001)

Accidents with property damage only

There will not be a detailed presentation of crashes with property damage here, since the results substantially confirm what has been discussed above. However, in contrast to crashes with bodily injury, many collisions also occurred in parking lots. One-third of property crashes involving older people showed this "crash site in the roadway system," the level was 36.9 percent for the 25-64 age group. This does not mean that middle-aged drivers tended to cause more parking-maneuvering damage. Quite the contrary. An analysis of the crash scenario shows that the group of older drivers is over-represented here. Lindauer (2007) used selected Allianz claims data to show that older drivers caused significantly more frequent parking and maneuvering damage with their cars. A closer look at individual cases in the available data again confirmed this result. Corresponding this, the driver assistance system supporting parking was registered more often for seniors (see below for more details). That middle aged drivers cause more accidents on parking lots may be due to less careful driving when entering/leaving the ground.

The claimants (second party involved) in accidents with casualties

For a total of 1,335 claimants the age was given in the 1,731 crashes that were considered. Of those, 87 (6.5 %) were seniors, of whom 23 (1.7 %) were over age 75. A total of 935 (70 %) were in the 25-64 age group, while 247 (18.5 %) were in the 18-24 group. Insofar, seniors

were underrepresented as claimants in this data in comparison with the general population. Sixty-one percent of the seniors as claimants were car drivers, 19.5 percent were bicyclists, and 11.5 percent were pedestrians. Now, the age distribution of the at-fault driver (first party) appears to be relevant: Almost two-thirds (N=54, 62.1 %) of the senior claimants were involved into the accident drivers of age 25-64, only 2.3 percent (N=2) by senior drivers. For the group of claimants aged 25-64, 40.6 percent of the at-fault drivers were age 25-64 and only 8.4 percent were senior drivers. The other crash characteristics were in accordance with what has been described before.

The claimants (second party involved) as pedestrians and bicyclists

It was possible to determine the age of N=49 out of all pedestrians who were in the claimants parties in the group under consideration. Ten (20.4 %) of them were seniors and 19 (38.8 %) were in the 25-64 group. In 24 cases (49 %) the at-fault driver was in the 25-64 age group, only 9 cases (18.4 %) involved at-fault drivers over age 64. Of the at-fault car drivers who involved the senior pedestrians (N=10) in the accident, 6 (60 %) were in the 25-64 age group and only 2 (20 %) were older than 64. It was possible to determine the age of N=166 out of all bicyclists who were the second party (claimants). 17 (10.2 %) of them were older people, and 92 (55.4 %) were in the 25-64 age group. The bicyclists were involved by at-fault drivers aged 25-64 in 85 cases (51.2 %) and by at-fault drivers aged 65+ only in 17 cases (10.2 %). Of the older bicyclists (N =17), who were involved by the at-fault drivers, 13 (76.5 %) were in the 25-64 age group and none was older than 64.

Again it is to be noted that most of the other accident circumstances follow the familiar pattern. Older pedestrians and bicyclists who are the second party involved in an accident (claimants) were primarily involved during the day, in urban areas, and under dry road conditions. According to this Allianz random sample, older people rarely caused senior pedestrian and senior bicycle accidents.

Claims expenditures

A general consideration of the claims expenditures resulting from crashes with bodily injury and property damage confirms the findings of international research and the German Insurance Association (Gesamtverband der Deutschen Versicherungswirtschaft, GDV). Accor-

ding to them, claims expenditures rise particularly among the older elderly (≥ 75) and even further at age ≥ 80. However, the group of senior drivers certainly can still hold their own with groups of younger drivers on average and are superior to "young" and novice drivers.

Driver assistance systems

The question of potentially being able to address crashes using modern vehicle technologies or advanced driver assistance systems (ADAS) merits particular attention. The graphics below show the percentages for mentions of selected assistance systems, which according to the individual case in-depth analysis related to the respective age classes. In that regard, multiple rater mentions of ADAS were possible for the same accident. Figure 94 shows the result of the rater analysis for all accidents with causalities (no graphic for crashes with property damage; *Driver safety/Attention/Fatigue* used as rating category does not correspond to a specific ADAS). Figure 95 shows the results for injury crashes broken down to three senior age groups. Results clearly show that a considerable number of systems could help with certain safety improvements specially for older drivers. Active emergency braking and intersection assistance (particularly left turn assistance) seem to be striking to address injury crashes, while parking assistance was noteworthy for collisions with property damage. It is obvious that the benefit of intersection assistance increases as older drivers age within the senior class.

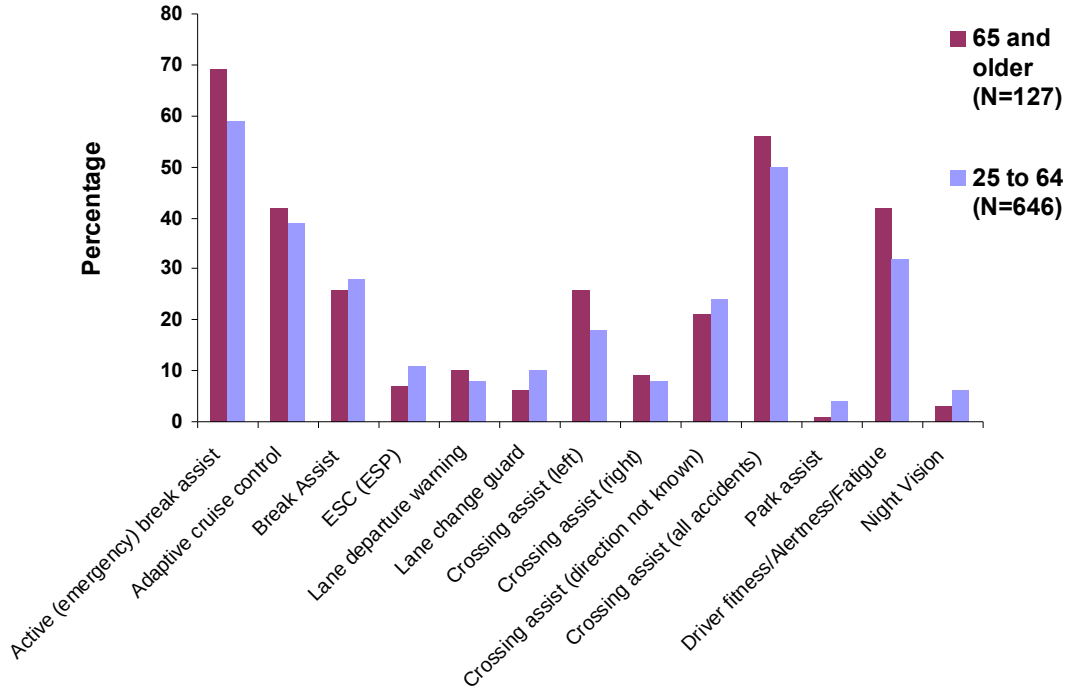


Figure 94: Addressability of injury crashes by selected ADAS in percentage by age (Allianz accident data)

Figure 96 uses the rate of system mentions per driver to illustrate the proven benefits for older people again. Left-turn situation has been repeatedly explored in the literature. In an experimental study for the German Federal Highway Research Institute, Dahmen-Zimmer (2005) showed the benefit of a parking assistance system for older drivers. Chapter 6 will return to the discussion of technical solutions to promote the safety of older people. Figure 97 summarizes the most important systems according to this Allianz evaluation.

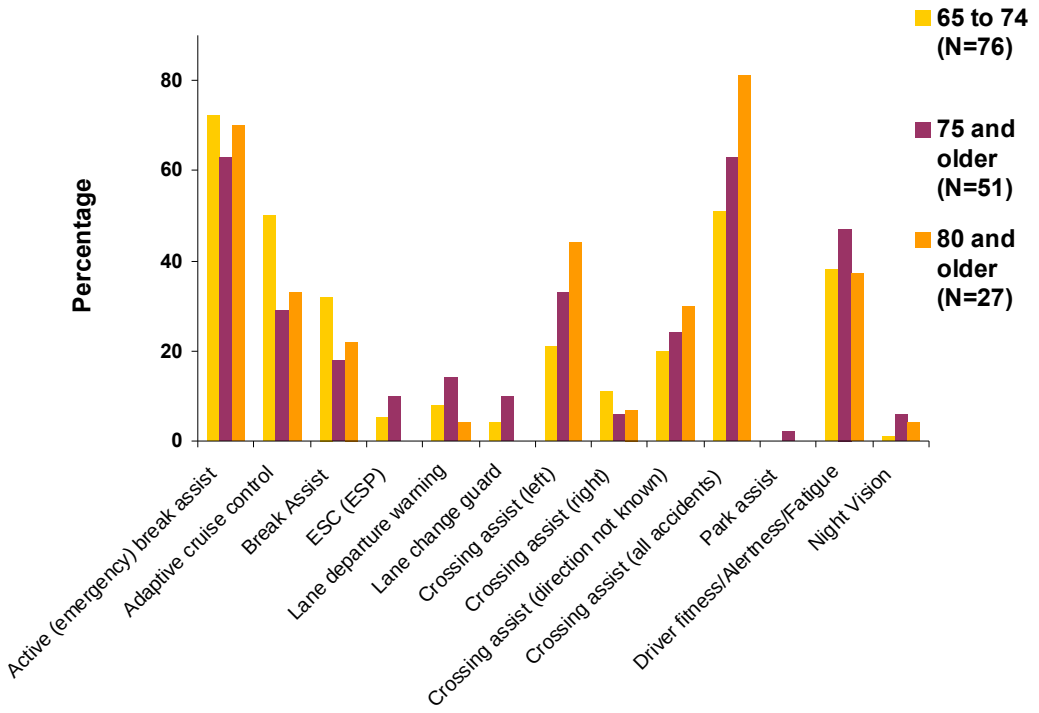


Figure 95: Addressability of injury crashes by selected ADAS for three senior age groups (Allianz accident data)

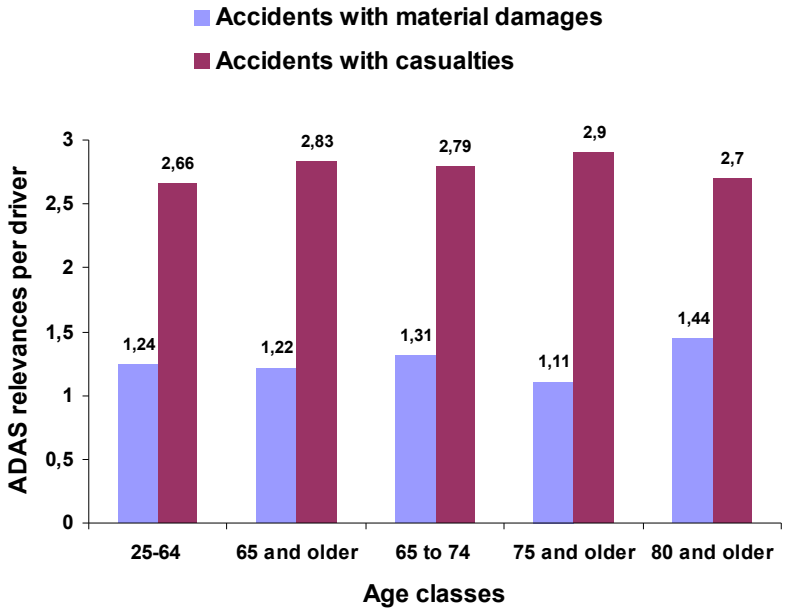


Figure: 96: Addressability mentions for selected ADAS, ratio per driver, by age (Allianz accident data)

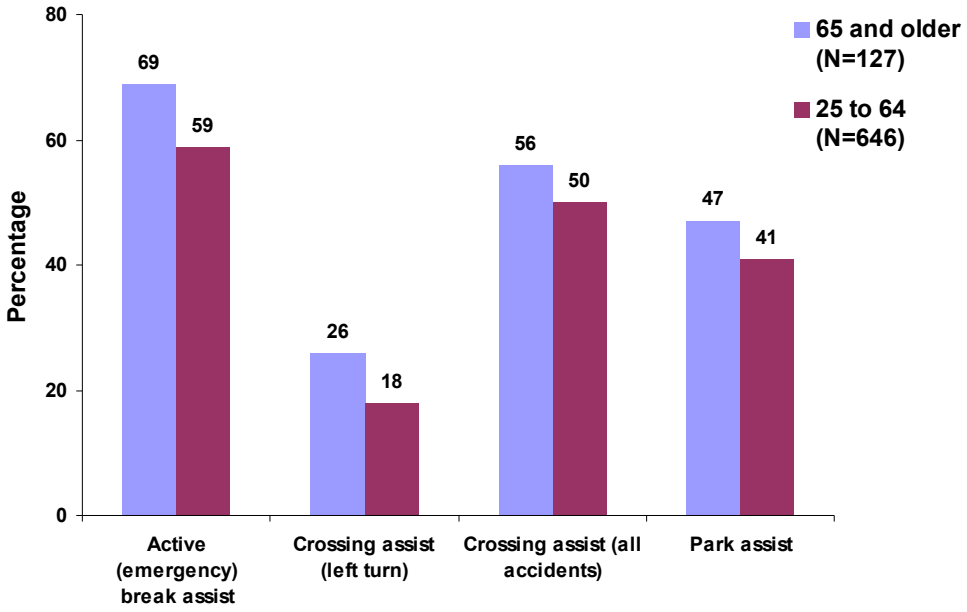


Figure 97: Addressability mentions for selected ADAS (figure legend: database for crashes with casualties. Park assist from database for crashes with property damage: age 65 and older N=81; age 25-64 N=287)

Parking assistance is particularly important when considering traffic accidents involving property damage. International studies show that the avoidance behavior of older drivers (in other words their voluntary self-regulation), also relates particularly to parking (Baldock et al., 2006): Older drivers spend more time looking for appropriate parking opportunities that do not involve backing in (but driving in forward) and are willing to walk longer distances for this. Parking assistance systems therefore not only have the potential to avoid collisions but also to promote the quality of mobility for older car drivers.

Chapter 6 will again discuss the benefits and acceptance of and requirements for advanced driver assistance systems from the viewpoint of the safety of older car drivers. Right now, the Allianz data in-depth study that is presented here makes one thing clear: Older drivers should not be neglected when developing and designing assistance systems, which offer great potential for accident avoidance.

5 Senior drivers' aptitudes, fitness, and driving behavior

So far we have discussed the overall accident figures, crash rates, and German federal statistics. But can they help to allay the prevailing skepticism about older drivers? Statistical averages show that older drivers may be viewed uncritically. But does this eliminate the concern about whether physical and cognitive deficiencies affect their ability to drive a motor vehicle? About their indivual risks? Before a more detailed discussion of those aspects, let's pause for a moment to recall the two examples that were mentioned in the introduction: people who drive the wrong way on the freeway and heart attacks at the wheel. Those two common examples clearly show that the general skepticism is not supported by solid data.

"Wrong-way drivers"

There are no current general statistics on unlawfully driving in the wrong lane against oncoming traffic (mostly on the highways); the German term for such drivers is "ghost drivers" [*Geisterfahrer*]. German federal accident statistics only refer to "*use of the wrong lane*" and a "*violation of the requirement to drive on the right side*" as registered driving errors; no distinctions are made as to age. Separate statistics on *use of the wrong lane (or wrong part of the street)* or *illegal use of other parts of the road* (rural and highway) show a total of 1,043 registered driving errors in crashes with bodily injury and 64 in crashes with fatalities for 2007 – both of them for all age groups. Legislators thus do not consider the traditional "wrong-way driver" to be sufficiently relevant to merit separate documentation. The few separate analyses that have been done indicate that the age factor does not appear to be decisive. That was the conclusion of a study by the Swiss Council for Accident Prevention (bfu). It evaluated crash data over five years (Figure 98). The total of only 86 cases was distributed over the age groups in a way that was not subject to authoritative statistical conclusions about the age factor. Descriptive statistics allow the statement that the mode (most frequent category) is in the middle-aged adult years (ages 45-64). The 25-44 age group actually includes more cases than the group of elderly drivers over age 74. A calculation of crash rates (for example per capita) would shift the image in disadvantage of older drivers, but it is methodically questionable due to the limited amount of available data. Overall, it has been shown that older drivers cannot be considered with certainty to be the typical "wrong-way drivers" headed up the highway. In contrast, another group has not attracted public attention:

Alcohol-impaired drivers are proven to be responsible for the majority of this driving error (bfu, 2006). According to bfu, 50 percent of all cases are attributable to the influence of alcohol. A study done by the German Federal Highway Research Institute BASt, in 1992, concluded that only 18 percent of cases were caused by older drivers, and an earlier Austrian survey from the 1990's concludes that the rate was only 21 percent for older drivers (in this case defined as ≥61); only 6 percent of wrong-way drivers under the influence of alcohol were older drivers, while two-thirds of them were under age 40 (Robatsch & Hagspiel, 2002).

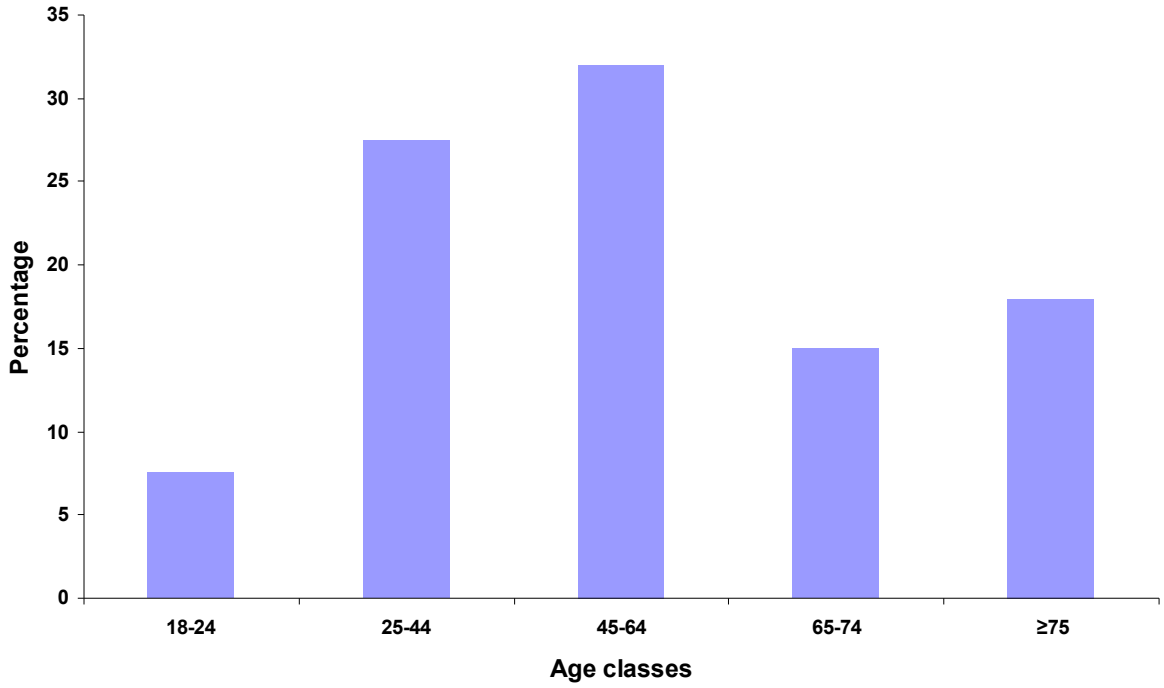


Figure 98: "Wrong-way drivers" involved in crashes in Switzerland 2000-2004, N=86 (bfu, 2006)

Heart attacks at the wheel

A heart attack. Aside from wrong-way drivers, no other incident involving an older driver is talked about so eagerly. But statistical support for this is lacking, too. There are hardly any clinical studies on the field of traffic safety research. A pilot analysis by AZT Automotive GmbH – Allianz Zentrum für Technik therefore considered data published by the German police. About half of all police stations and headquarters in Germany use the press portal of Deutsche Presse Agentur dpa to publicize major crash incidents. This includes unusual features such as serious crashes at the tail of a traffic jam or a driver who suffers a heart attack. Evaluation of all accident and incident documents for the 12-month period from September 2007 to August 2008 showed N=41 cases of a verified or presumed heart attack in a driver at the wheel of a motor vehicle, 56 percent of whom were younger and only 44 percent of whom were older

than age 65. There were twice as many truck drivers in the 37-57 age group as car drivers over age 74 (Figure 99). Again, for methodical reasons, the data from such a pilot analyses cannot easily be qualified by reference variables such as population or mileage; this would paint a less favorable picture of the group of older drivers as a whole, of course. But nevertheless, even based on population the heart attack crash rate for drivers in the 65-74 age group is only 0.16, just slightly above that of the 50-59 age group at 0.11, while the rate for drivers over age 74, which is about 0.04, is less than that for the 25-64 age group at 0.05. Overall, it must be noted that this data in no way allows the conclusion that the heart attack is a physical failure at the wheel which is predominantly typical of senior drivers – in spite of a presumed higher rate.

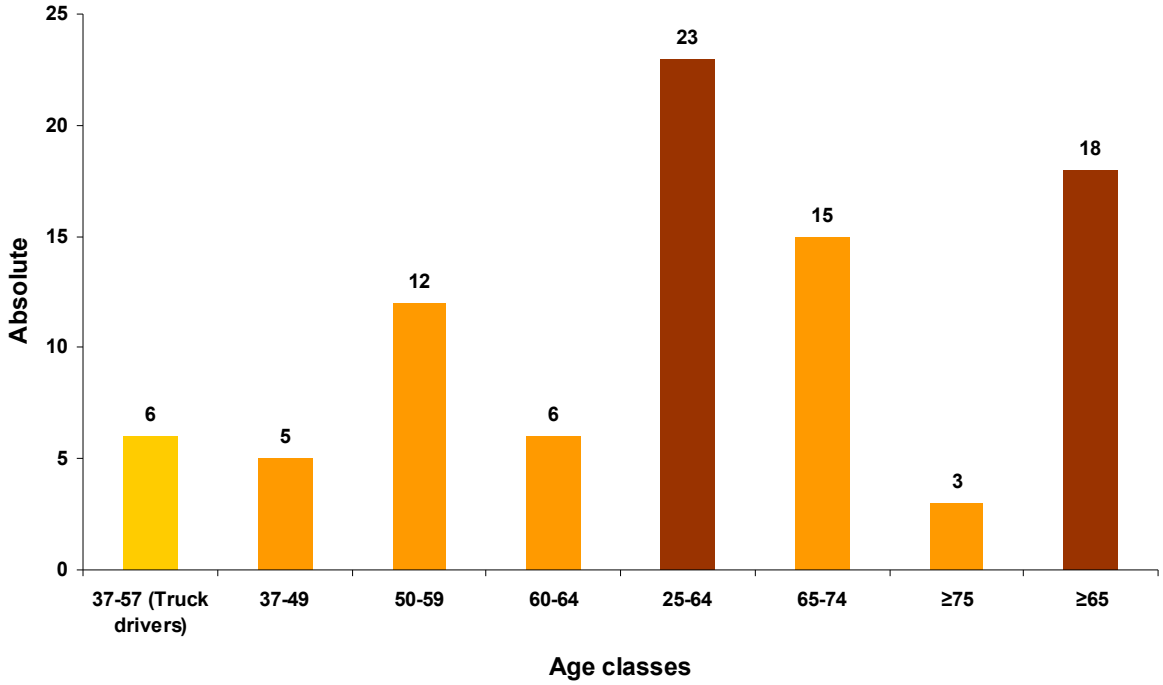


Figure 99: Car/truck crashes caused by heart attack (or suspected heart attack) according to police reports during the 12 months from 9/2007 to 8/2008 (N=41)

"Wrong-way drivers" and heart attacks at the wheel are seldom events in terms of crash statistics, and no reliable conclusions can be reached about how the probability that they will occur is istributed over various age groups. However, in terms of their absolute distribution, drivers under age 65 appear to be affected more frequently than older drivers. That was certainly the prominent case in the recent incident reported in the *Süddeutsche Zeitung* newspaper with the headline *Drama involving Bayreuth Festival head Wagner*, (SZ, 2008). The Festival's in-house counsel, age 32, died of heart failure while driving on the Autobahn accompanied by passenger Katharina Wagner.

Senior car drivers – Driving errors and types of accidents

Objections to older drivers are generally based on the errors that are attributed to them and the assumption that they are driving in spite of diminished physical and mental capabilities. According to the general conclusions of international research, older people have particular problems with complex traffic situations that require them to percept and process information, make decisions, and act quickly, particularly when entering intersections in high-volume or dense traffic. This results in right-of-way violations. A defined "need for time" characterizes the senior as a traffic participant. The literature also discusses problems when driving at night or at twilight and merging at high speeds. In contrast, the driving behavior of older people has little to do with speeding and drunk driving. That is also reflected in the driving errors that are officially recorded for traffic accidents in Germany: Figure 100 combines all driving errors by age and an initial view shows that the group of older drivers is more error-prone. But it must be remembered that these are error rates for 1,000 people in the individual age class who are involved in injury crashes, not absolute values (see the above explanation of the term primary at-fault rate).

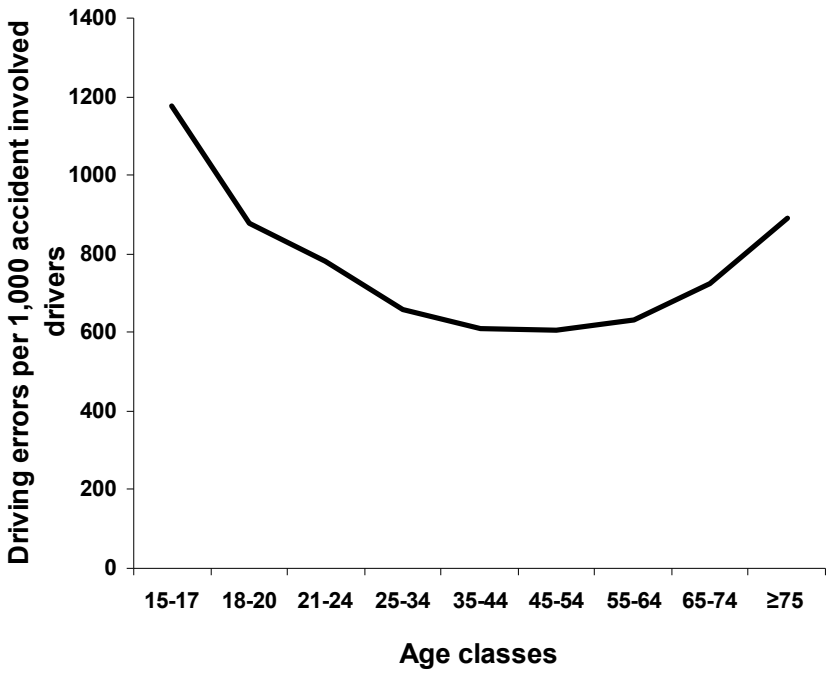


Figure 100: All driving errors by age per 1,000 drivers involved (at-faults plus second party) in crashes with casualties, 2006 (Database: StBA, 2007)

A closer look at the group of drivers on record in the German Federal Motor Transport Authority [KBA, *Verkehrszentralregister*] shows an increase in driver errors per 1 million kilometers mileage (KBA, 2008). If an older driver is involved in a car crash with bodily injury, it is more likely that the police will put driver errors on record. That is immediately apparent from the fact that there is a high probability that the older car driver is primarily at fault, when involved in an accident. Figure 101 provides the details. It confirms the characteristic problem of older car drivers which is described above (see below for alcohol offenses; it should be noted that the broad class of "improper road use" [*falsche Strassenbenutzung*] is not the same as "wrong-way driving" [*Geisterfahrt*] or "wrong lane use" as dicussed above).

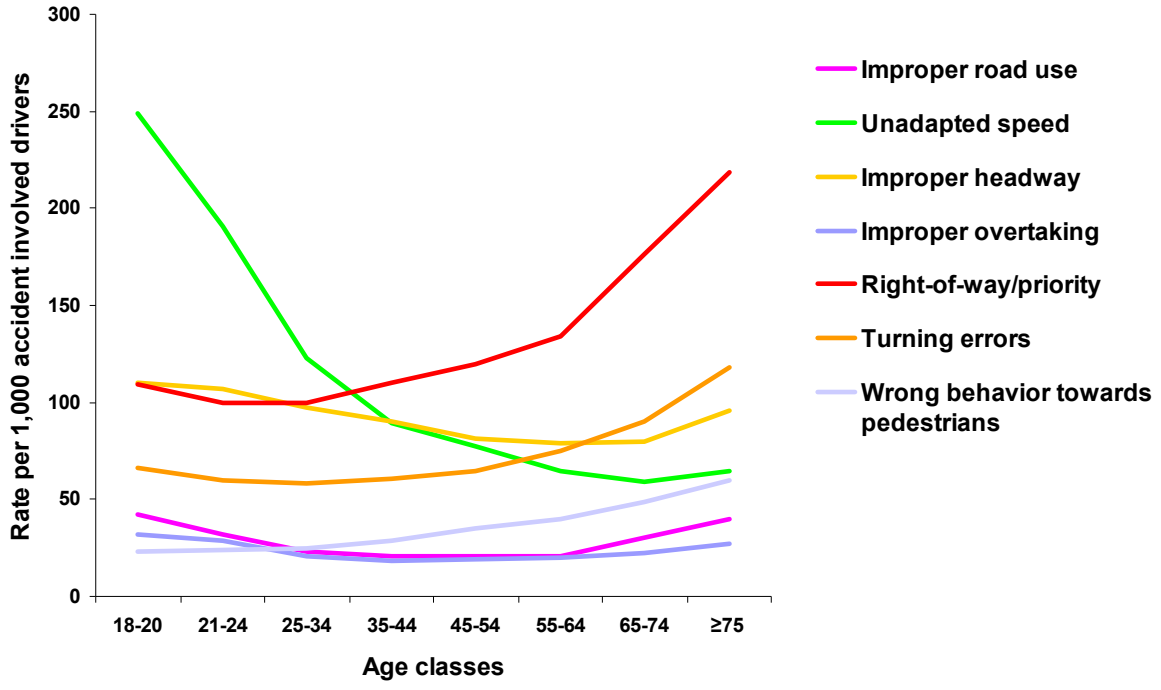


Figure 101: Selected driving errors by age per 1,000 drivers involved in injury crashes, 2006 (Database: StBA, 2007)

Driving errors by men and women differ in a way that at least justifies the hypothesis that teaching efforts should also be customized by gender. For example, women make many more distance errors as they age, and distance and right-of-way/priority errors are by far the most serious errors that they make (well above other errors), while older male drivers make fewer distance errors and the other types of errors they make are charted closer together (no graphic). The issue of driving error with regard to pedestrians is somewhat problematic. The

slightly higher curve for older drivers gives rise to the suspicion that older pedestrians, who are at particular risk anyway, are more often involved in crashes due to older drivers. The analysis of accident claim files in the Allianz database did not confirm this, but the number of cases was low. A separate analysis of the absolute number of crashes in German federal statistics by age according to second party involved in the crash would be needed for future research. According to AGILE (2001), the *pedestrian* collision type (in Belgium data) shows an increase with age, although it is very slight. Finaly, the age distribution by "type of accident" of at-fault car drivers in crashes with bodily injury provides some more information about this question for Germany. Figure 102 shows the pattern of absolute numbers.

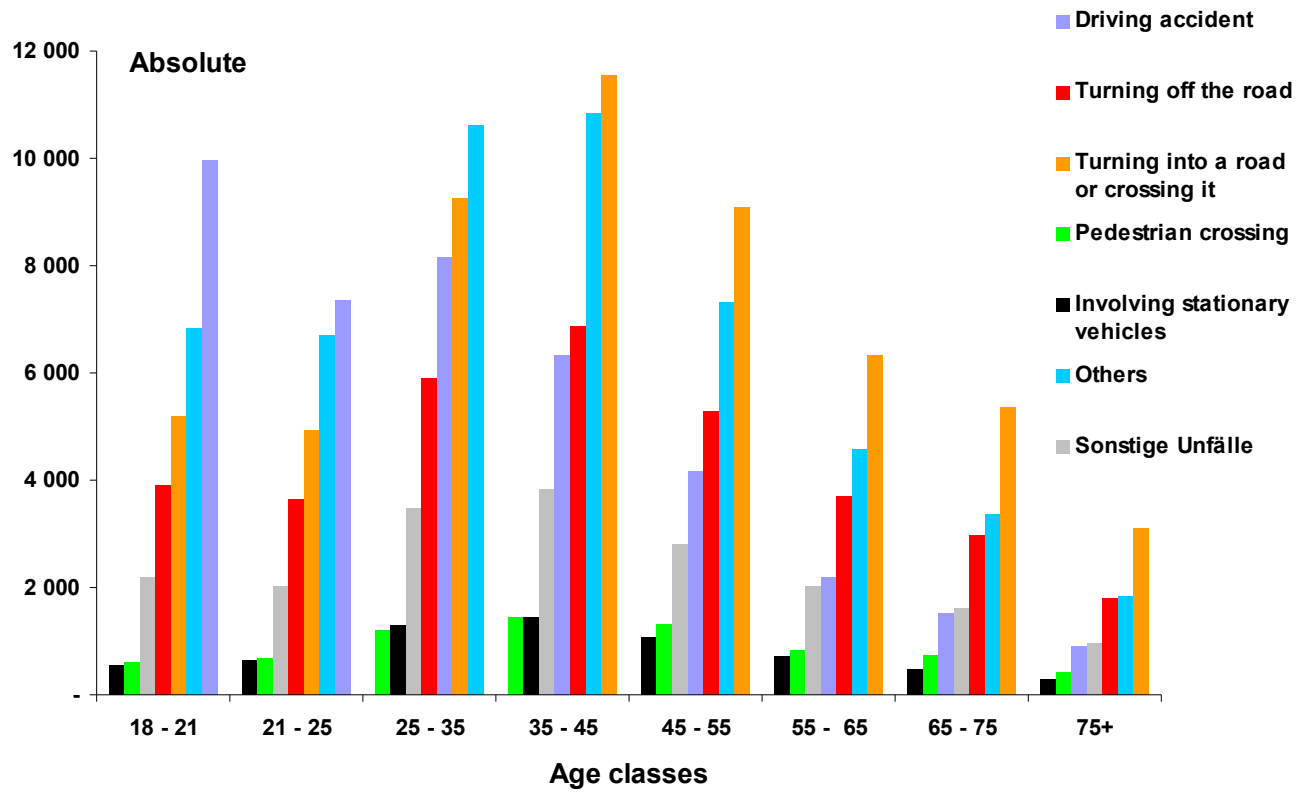


Figure 102: Type of accident for car drivers who are primarily at fault in injury crashes by age and respective ranking, 2006 (separate analysis on the base of StBA data, 2007)

The absolute accident numbers show that the same ranking of crash types can be found for all drivers over age 35 who are primarily at fault in a car crash with casualties. Consequently, it is not just older drivers who have problems with turning into/crossing intersections, as shown and argued on the base of the distribution of driving errors per 1,000 crash-involved drivers. Finally, there is an approximately identical ranking of crash types for all age groups over 35.

Looking at crashes involving pedestrians, the *run-over crash* type in German statistics includes pedestrians only, when crossing the street as a pedestrian, and they are not subdivided by age, either. However, this crash type also shows nearly the same ranking for almost every age group. In terms of absolute numbers, it is lowest for older drivers. Figure 103 offers some perspective for the numbers per 1,000 car drivers who are primarily at fault. It shows that older drivers do not decisively cause more crashes involving pedestrians crossing the street. There is a comparable rate, at least over all ages over 44. This figures once gain make clear that the turning into/crossing intersections crash type does increase with age, but it is also very relevant for younger drivers. Further studies on age-relations in driving errors might be necessary.

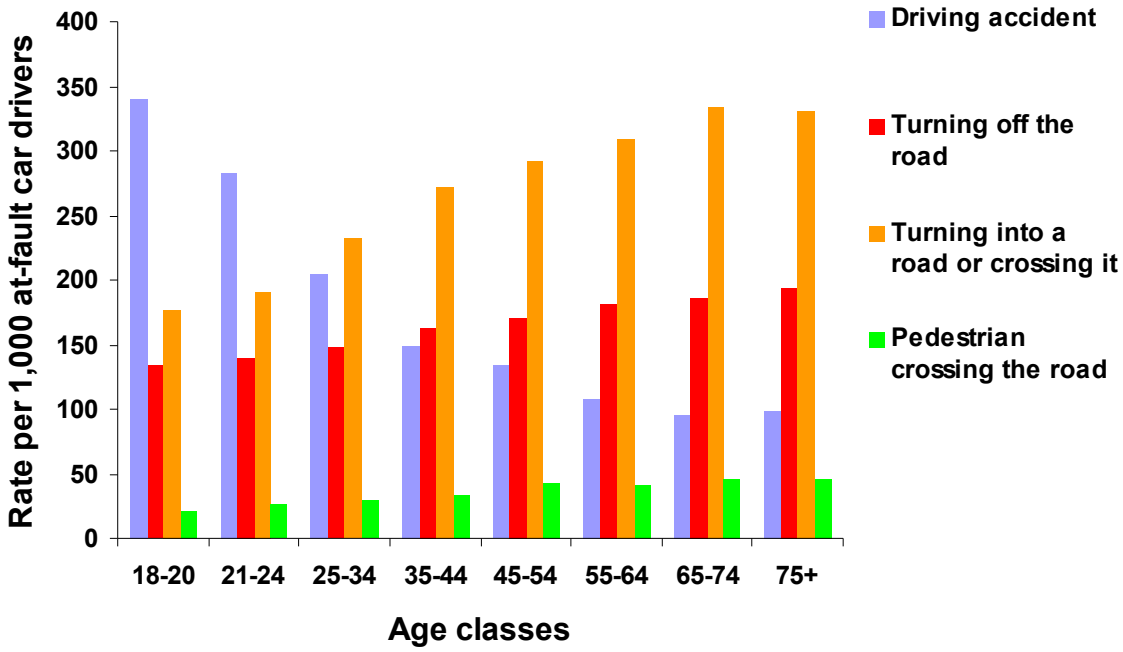


Figure 103: Selected types of accidents for car drivers who are primarily at fault in injury crashes per 1,000 car drivers who are primarily at fault, 2006 (Database: StBA, 2007)

The discussion on the issue of older drivers' fitness for participating in motorized traffic begins with Figure 104. For one thing, the results of the age distribution of the driving error that is identified by the police as "impaired fitness for driving" shows – as is generally known – that seniors almost never drive under the influence of alcohol. The impairment due to fatigue, at any rate, does not increase, at least. For most drivers in the younger age groups, those two aspects make up the majority of driving errors associated with fitness for driving. If driving

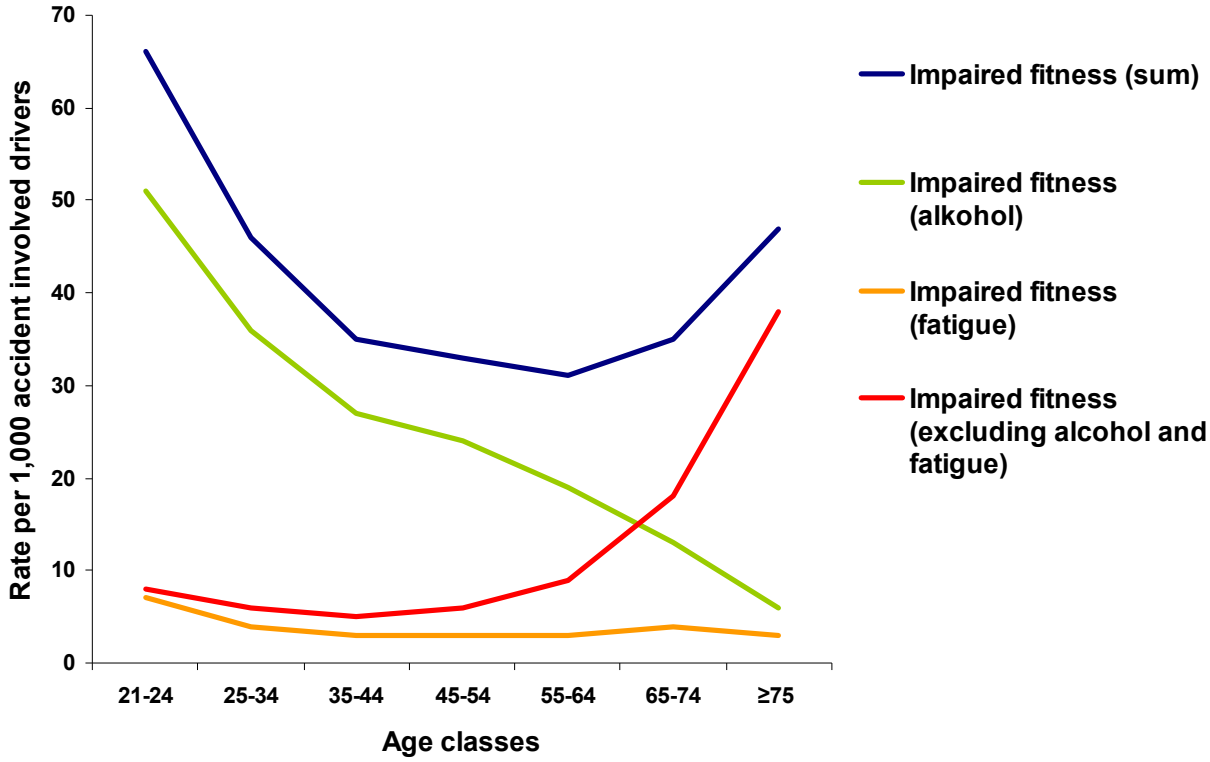


Figure 104: Car driving errors related to fitness for driving in injury crashes per 1,000 crash-involved drivers (at-fault plus second party) in the individual age class, 2006 (Database: StBA, 2007)

under the influence of alcohol (DUI) and fatigue are subtracted from the total, it becomes clear that the age-related increase in driver errors related to fitness for driving is substantially explained by other aspects (that are generally not specifically documented for record). They can include illness, physical infirmity, prescription drugs and medications, and others. This distribution supports the assumption that older drivers who are involved in injury crashes are more likely to have health problems than younger drivers. But it must be remembered when interpreting the data: Those rates per 1,000 people involved say nothing about the frequency of occurrence in terms of absolute figures (see above on term primary at-fault rate).

Driving aptitudes in senior drivers – The German Expertise on Driver Aptitude

According to international scientific findings and the German Road Traffic Act [*Straßenverkehrsgesetz*], a distinction is to be made between having a general competence to drive [aptitude, *Fahreignung* or *Fahrtauglichkeit*] and being fit to drive [*Fahrtüchtigkeit*]. The latter refers to temporary impairments of physical or cognitive functions that ensure safe driving of a motor vehicle on public roads – the state factor in terms of the state/trait concept of perso-

nality. Impairments of fittness are limited as to time and can be established by situation-dependent circumstances as by illness or alcohol. *Aptitudes* refer to the trait factor and define the ability – the needs – to drive safely as a whole; it includes physical and mental factors that are stable over time and situation. It is put as an undefined legal term German Traffic Act. Even with being fit to drive, the authority may impeach the license (e.g. disabilities). Other European countries know similar regulations at least. As to cars drivers (license class B), only minimum requirements for physical and cognitive performance are linked to it. Special requirements as to taxi, bus, or truck drivers cannot be discussed here. Legislators also speak of requirements for character traits which must be fulfilled (relating to aspects of behavior such as violent offenses in road traffic and others).

The fitness and aptitudes to drive on license B (car) in Germany is considered to be unlimited as to time yet, i.e., with regard to age, that will change with 2013, when all Eu members will have a 10 (or 15) year limit (more on the controversial license situation in Europe see chapter 6 *The driver license*). Several countries, as the Netherlands or United Kingdom do, go this way right now and reqiue certain testing for renewal. Not so Germany. However, if circumstances cast doubts about the license requrements (such as a chronic illness, an addiction, or relevant criminal offenses) to the authorities, the citizen is required to provide evidence that allays the concerns (for example in the form of an examination), so the presumption of innocence does not apply (for details see the German Driver's License Regulation [*Fahrerlaubnisverordnung*, FeV]. There are official guidelines for examination and expertise on the drivers' fitness and aptitude in Germany, since 2000 based on a combination of the Expert Report on Illness and the Psychological Expert Report on Driver Aptitudes (BASt, 2000). This German guidelines define medical and psychological standards, which are not based on age, for evaluating clinical pictures, behaviors, and circumstances that have been proven to reduce the fitness and aptitude to drive. The German traffic medicine society DGVM and the German traffic psychology society DGVP have jointly decided to add a chapter on older drivers to the guidelines (DGVM & DGVP, 2006). Nonetheless, a legal definition of drivers' fitness and aptitude is effective, which does not depend on age.

There is a great deal of in-depth literature on the question of what influence specific clinical or symptomatic pictures may have and what forms of treatment can affect physical or cognitive functions in drivers which are relevant for fitness and/or aptitude to drive. There is also plenty

of literature about which age-specific physical and psychological changes can have such an influence; however, it is not easy to arrive at definitive statistical conclusions on risks to road traffic, as shown by the hotly contested issue of *prevalence* (as a measure of the distribution of a certain attribute in the population on the one hand and in road traffic on the other hand). Reference is made at this juncture solely to the frequency of driving under the influence of drugs. The safety of older people (as drivers) requires reliable information on the probability of occurrence of revenant characteristics (for example use of medications relevant to driving) both in the age class and in driving. Risk assessments can hardly be more complex where methodology is concerned. This also applies to the analysis of crashes and their causes: In-depth crash databases, such as the one at the University of Hanover (German In-Depth Accident Study, GIDAS), are working in that direction, but there is still a lack of statistical information for Germany as a whole.

It can generally be said that when a disorder occurs that reduces fitness or aptitudes to drive, the risk of an accident during active road use (primarily in a motor vehicle) increases. But those are statements from clinical studies on the risk of being involved in a crash, usually known as odd-ratio analyses of case and comparison groups. An overview is provided by Ewert (2008), who states that probabilities of crashes can be assigned to specific disorders. The studies give an impression of which risks should be the focus of efforts to improve the safety of older people, because certain disorders correlate with age. For example, (untreated) *diabetes mellitus* is among the crash risks that are repeatedly mentioned (Vernon, et al., 2002, cited according to Ewert, 2008; Vaa, 2003; Charlton, et al., 2004; Dobbs, 2005; Sagberg, 2006). *Neurological disorders*, *depression*, and *sleep disorders* and apnea must also be considered critical. These studies were limited to recording the occurrence of a crash after the clinical diagnoses that are given. The question of the stage of the patient's disease and how successfully he has been and is being treated is decisive for assessing the drivers' fitness. On the other hand, many studies from the viewpoint of gerontology are often not truly helpful, as shown by the example of the EU Driver Health and Crash Involvement project (IMMORTAL, 2003), whose division of older drivers into 61-70 and ≥ 71 is not adequate for findings on crash statistics.

Aged-based ("senior" related) risk analyses are therefore subject to many reservations. References to some disorders come from the European Union AGILE project (2001). AGILE

conducted a driver survey that distinguished between older people in the 65-74 and ≥ 75 age groups. According to the survey, older drivers did not mention diabetes significantly more frequently until after age 75; back pain, kidney disease, or arthritis were not mentioned significantly more often by older drivers against under 65. There were increases in hearing difficulties, cataracts and glaucoma; visual problems rose only between 55-64 and ≥ 65 and remained stable as drivers aged. A past heart attack was not mentioned more frequently, but heart disease in general and arrhythmias were. According to the survey, stroke seemed to be an increasing concern above age 75. Finally, a very low percentage of older drivers mentioned dementia and depression. This clearly shows the limits to such surveys, because 0 percent dementia in the 55-64 and group and 1 percent for ≥ 65 and ≥ 75 appears plausible only because the survey was limited to fully active drivers, so there was a positive selection in the random sample. Moreover, it is more likely that some type of inaccurate self-reporting is involved with this type of disorder.

On the contrary, according to literature, *dementia* disorders are particularly important for the safety of older drivers (Mix et al., 2004, and others), in addition to depressive and other neurological disorders. In contrast to many other disorders – for example a past cerebral infarct, which in some cases can be well compensated – they are frequently not appropriately perceived. AGILE (2001) reports an approximate 15 percent prevalence of any degree of dementia in the population older than 64; at the same time it must be presumed that 20-30 percent of everyone with the disease continues to drive. Charlton, et al. (2004) states that there is a clearly increased crash risk (OR 2.1 to 5.0) for people with dementia (no age distinction). Due solely to the increasing percentage of older people in the population, dementia disorders remain an important aspect of the safety of older people which must still be explored.

A second area of emphasis is the problem of multiple morbidity and multiple medications, as well as *long-term* drug intake in the elderly. Figure 105 shows the results for multiple diseases among older people in the age survey of the German federal government (2002). Note that one-third of people in the 40-54 age group have two to four disorders. But the age survey says nothing about the relevance of those diseases for fitness to drive. It should be emphasized that there is a specific need for education campaigns and consulting for older people, given the increased likelihood of long-term illness and the associated reduction in general well-

being and capacity, as well as the associated intake of medications. The senior specific address focussing aspects of road use, illness, and drug intake – instead of general suggestions that really apply to people of all ages with illnesses – is currently not at all satisfactory, as also observed by the German traffic medicine at the Federal Highway Research Institute (Becker & Albrecht, 2003). Even apart from senior driving, a lack in information policy and counseling given by physicians is to lament with respect to driver impairments. It will be necessary to strengthen efforts in expert training including knowledge about the effects of prescribed medications on road safety (that are particularly all psychotropics, analgesics, and antihistamines). With that in mind, the Federal Highway Research Institute created a training program for family practitioners (see BASt, 2007). It is also discussed in Chapter 6.

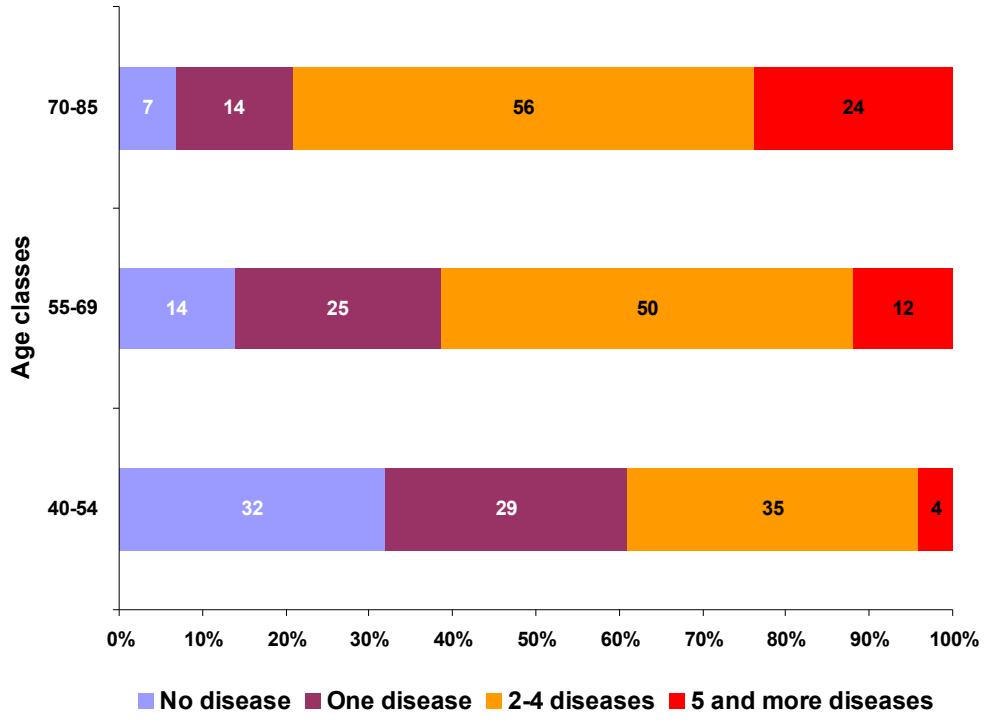


Figure 105: Frequency of multiple disorders by age (according to German Age Survey, 2002)

The utmost complex issue of changes in psychological functions in the elderly and its relationship to driving cannot be explored in greater detail here. Reference is made to the plethora of publications (Schlag, ed., 2008, provides a comprehensive overview). The cognitive aspect of information processing in complex road traffic situations, which can involve delayed reaction times in older drivers, has been mentioned before. But older drivers also need more time to operate systems in the vehicle (for example, Totzke, Hofmann & Krüger, 2003). Age related aspects in mental and performance functions must be discussed, including reaction and at-

tention (choice response behavior, selective, divided or shifted attention, prolonged attention, etc.), psychomotor domain, or perception (peripheral perception, perception of speed, distance estimation, visual search, useful field of view, and others). Older people need more time, both physically and mentally, to fulfill the requirements of specific mobility tasks. But the importance of those mental performance functions for safely driving a motor vehicle should not be overestimated. That is because minimum requirements related to drive (at least to achieve the lowest average range according to standardized psychological test procedures) are sufficient, legally and from the view of traffic safety research – and also healthy seniors use to achieve the defined minimal testnorms (taking into account that testnorms consider the age factor). If the minimum requirements are not fulfilled, more in-depth examinations and ultimately also test drivings allow to double check the individual compensatory resources. A complete discussion of research on psychological performance functions and potential crash risk is offered by Tränkle (1994), among others. In contrast, the question remains of how safe older people themselves feel. That also determines the safety of their actions. According to AGILE (2001), drivers do not report memory and attention problems with significantly greater frequently until after age 74. It is also clear that drivers over age 74 report more difficulties in reacting quickly when required by the situation (Figure 106). Both subjective and objective performance capacity are ultimately necessary for safety.

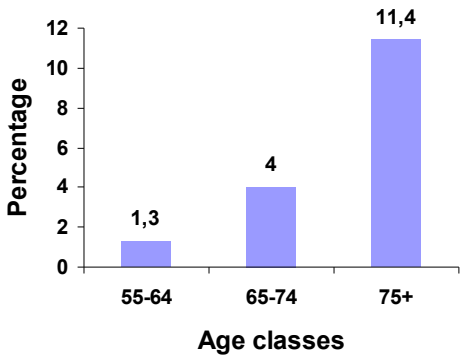


Figure 106: Self-reported difficulty in reacting quickly enough while driving when required by the situation (AGILE, 2001)

In contrast, personality-related aspects have not been the focus, when discussing certain weaknesses in older drivers. Thus risk behavior, sensation seeking, competitiveness, aggression, or conscientiousness, as well as delinquency, still tend to be most typical personality traits in young and novice drivers and offenders (Kubitzki, 2007). Heinzmann (2001) has shown that traffic offenses and violations obviously decline with age in Germany (Figure 107).

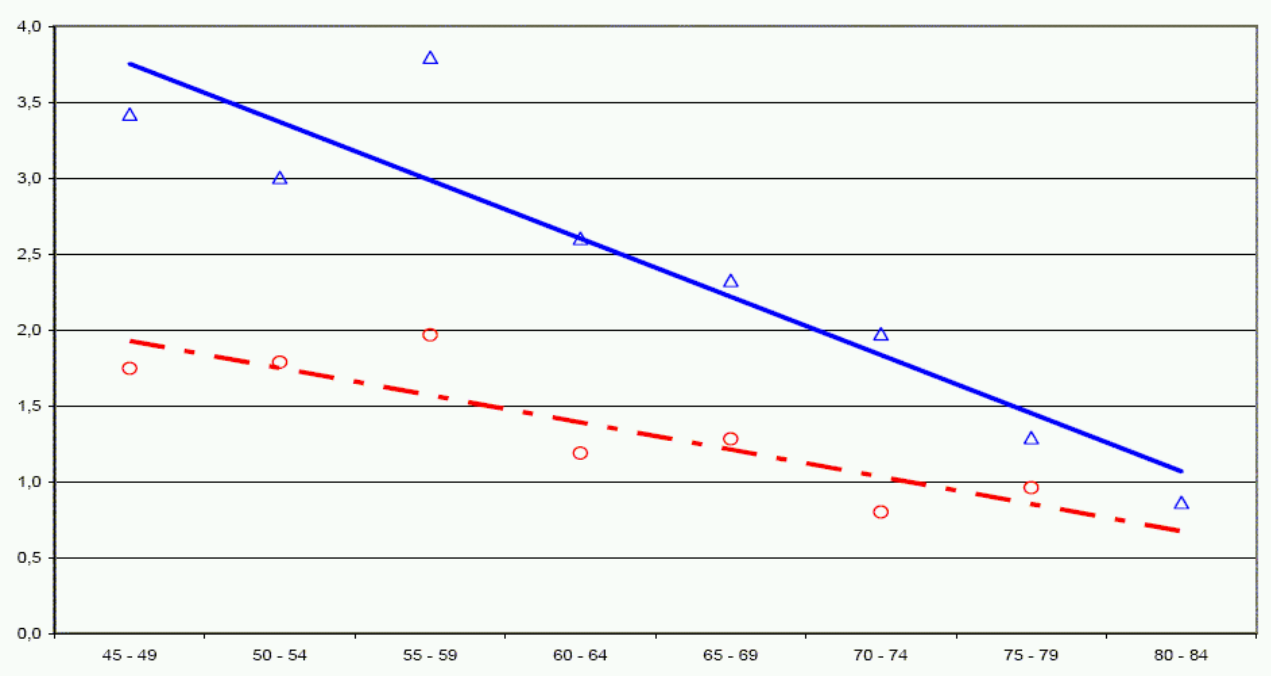


Figure 107: Traffic violations per 1 million kilometers mileage by age in Germany (KBA, 2008)

Notwithstanding all of the research results, psychological functions, like it is for physical capacity and disorders, must be assessed and evaluated in every individual case. As the law now stands in Germany, the question of whether psychological functions are impaired in a way that a risk is posed to other road users – and where the individuals driver's license is concerned – must be decided only in the individual case, not in reference to experimental groups or results. This is due simply to high intra- and inter-individual differences in performance, and this is the fact for all age groups. This is one of the reasons why German legislators have to this day rejected general mandatory requirements (tests) for older drivers only. The majority of experts in Germany believe that individual advisory services in the areas of traffic medicine and traffic psychology, as well as voluntary examinations, are far more useful (see Chapter 6).

Compensatory behavior in senior drivers

Older drivers compensate for their own weaknesses by avoiding critical traffic situations – this is a familiar statement. But there is little objective statistical data to confirm it, aside from the generally low mileages driven and some interview surveys. AGILE (2001) found that older drivers are significantly more likely to avoid long drives (defined as over 45 minutes). It is

surprising, although plausible, that they also attempt to avoid both city driving and the freeway. They do not attempt to avoid driving on rural roads (there they are especially dependent on travel by car). It therefore appears that older drivers are well aware of the stressful city traffic situation, which is where the majority of crashes with material damage tend to occur. The survey also shows attempts to avoid other circumstances that make driving more difficult (darkness, bad weather, rush hour, unfamiliar routes, time pressure, passing, and intersections). Of course this is self-reported information.

It is known that older drivers have fewer crashes in the dark. But with regard to the issue of potential avoidance behavior of older car drivers, it is also of interest to determine how many older drivers are primarily at fault in crashes that occur in the dark. A separate analysis by the German Statistical Office which was done for AZT Automotive – Allianz Zentrum für Technik has confirmed that older people are less often primarily at fault in injury crashes at night and under other difficult driving conditions than younger drivers (Figure 108). The percentages that are shown represent the percentage of all car drivers who are primarily at fault in injury crashes which have occurred under the relevant situation within the individual age class. It shows that only 11.6% of all car crashes in which older drivers are at fault occur at night, with the rest occurring during the day, at twice the rate for middle-aged drivers and three times as much as for young drivers. Older drivers also obviously expose themselves less frequently to other difficult external circumstances. For example, the percentage primarily at fault under the road condition criterion (icy, wet, etc.) is also lower. In contrast, bad weather causes driving conditions that are no doubt least popular for all age groups. Of course, considering the figures of drivers who are primarily at fault in different situations cannot provide sufficient evidence of avoidance behavior of the individual situation. It does show the extent to which each age group is involved in crashes in that situation, and one might argue that older drivers simply handled the situation more cautiously. However, the common U-shaped curve for car drivers who are primarily at fault argues against that, since it shows that it is precisely when older drivers are involved in crashes that they tend to be at fault. But the data shows compensatory behavior even without this considerations. In addition, older car drivers are much more likely to adapt to the requirements of a trip, particularly by reducing their speed more and maintaining greater distances (see AGILE, 2001, among others). This can be seen as one of the reasons for the lower percentage of the absolute sum of all primary at-fault crashes. However, this behavior may not be able to reduce the higher primary at-fault rate over the

long term given the fact that the characteristic cognitive problems of older drivers in complex situations cannot be completely remedied by reducing speed and maintaining appropriate distances.

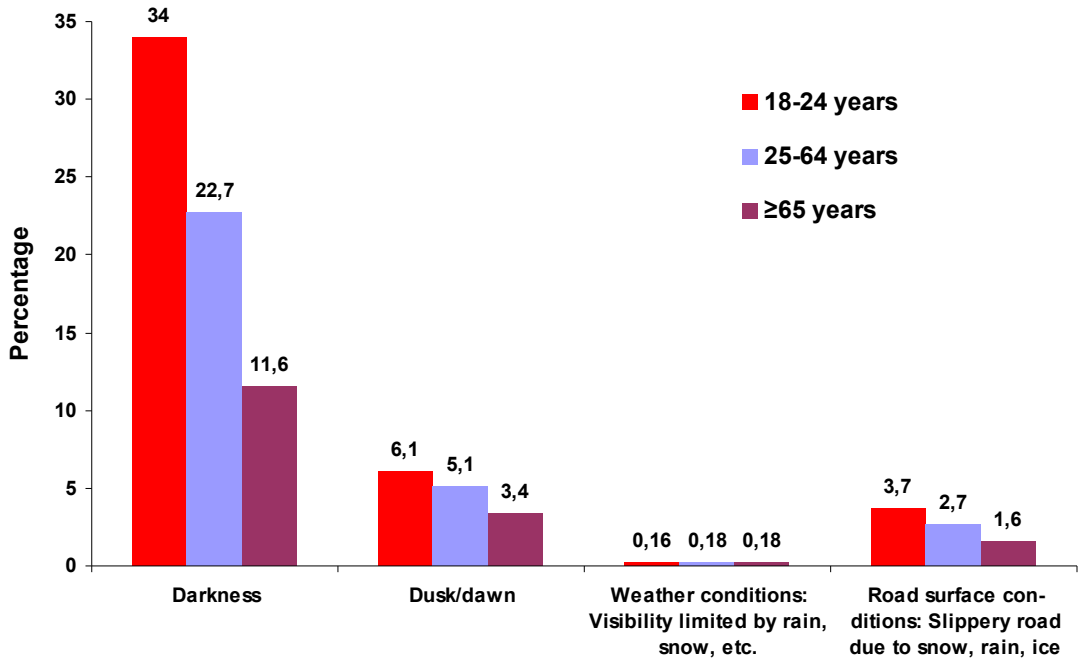


Figure 108: Car drivers primarily at fault in injury crashes under certain conditions as a percentage of all car drivers who are primarily at fault within the individual age group, 2006 (Database: StBA, 2007)

The result speaks for itself. Whether or not driving is avoided, the risk of being involved in a serious accident at night by a driver over age 64 is much lower than the risk posed by drivers in the 18-64 age group. This information on avoidance behavior concurs with existing knowledge from subjective sources.

The University of Bonn researched the overall compensatory behavior of older drivers for the Federal Highway Research Institute from a theoretical point of view and observed that ultimately only 5 percent of older drivers could be said not to have appropriately coped with existing shortcomings. There was a certain lack of clarity in the classification for another 16 percent of drivers. The vast majority of drivers use appropriate mechanisms to avoid their own deficiencies, which included insight into those deficiencies (AEMEÏS/Jansen, et al., 2001).

Note, however, that Mix, et al. (2004) found that older drivers with dementia, in particular, are often unable to be self-critical in this way. Experts agree that, aside from those clinical ex-

ceptions, older drivers are very well aware of their limitations and take steps to compensate for them, mostly by self-selection (route, time, incident-based restrictions, or giving up driving entirely).

Engeln & Schlag have explored the compensation strategies of older drivers in greater detail (2008). According to the general gerontological compensation model SOC (selection, optimization, compensation), measures for coping with tasks and objectives (of a driver), in addition to limiting one's driving, are still advisable, as shown by the above references to the benefits of improved vehicle equipment or advanced driver assistance systems. This also includes route preparation, for example, when a driver must travel on an unfamiliar road section. AGILE (2001) has shown a need for improvement in this area, particularly for the older elderly (≥ 75). Only 35 percent of them take advantage of such preparation, compared with 51 percent of the younger elderly and 43 percent of drivers in the 55-64 age group. There is no lack of points of contact to be used in educational efforts for senior drivers.

Compensation strategy	**Objective of action**	**Means of action relevant to objective**	**Relationship to mobility**
Reduction of objectives (selection I)	Reduction up to elimination of objectives	Means unchanged (e.g., use car)	Drive less, choose (e.g., avoid driving at night)
Change in objectives (selection II)	Choice, development of new objectives as a substitute	Means unchanged	e.g., change behavior during leisure time (choose closer destinations)
Restoration of means of action (optimization)	Objective unchanged	Strengthen, refine, practice (e.g., skills and abilities of the driver)	e.g., health measures related to the driver, assistance systems in car
Substitution of means of action (compensation)	Objective unchanged	Create/use new support means	e.g., use alternative transport modes

Figure 109: Compensation mechanisms according to the SOC model (modified and supplemented cited according to Engeln & Schlag, 2008)

Excursion: Visual perception

The need for regular visual acuity tests should not be denied, since drivers in all age groups show a high level of ignorance in this area (ZVA, 2005). On the other hand, the fact should not be underestimated that international research considers mere daytime visual acuity generally

to be of subsidiary importance for traffic safety. Instead, other factors related to ophthalmology and perception psychology, such as sensitivity to glare, visual difficulties at twilight, and glaucoma or cataracts (Figure 110), and perception psychology, such as limitations to the useful field of view (UFOV, not the same as field of vision) or peripheral perception and target detection, have been described in senior drivers.

When advising and educating older drivers, regular, complete care by an ophthalmologist should be recommended, in addition to a visual acuity test. The additional examination of the psychological perception and reaction behavior could be subject of a voluntary psychological testing study by the medical-psychological examination centers (see Chapter 6).

Disorder	**Risk (OR)**
Cataracts (Charlton, et al., 2004)	2.1 to 5.0
Glaucoma (Charlton, et al., 2004)	1.1 to 5.0
Visual field (IMMORTAL, 2003)	1.3
Myopia (Vaa, 2003; Sagberg, 2006)	1.09 to 1.2

Figure 110: Crash risk of visual functions, unrelated to age

Driver behavior and drivers' aptitudes – Summary

Older drivers are involved in certain crash scenarios based on characteristic problems of information processing under time pressure and in complex traffic situations. For example, older drivers are involved in crashes at intersection areas and crashes related to the failure to yield the right-of-way. However, German crash data also show that these problems, which increase with age, are not really just age specific, for turning into/crossing an intersection crash type is the most frequent one for all car drivers over age 35 who are primarily at fault in injury crashes.

Nonetheless, it cannot be forgotten that several disorders and drug treatments (or misuse of drugs, primarily benzodiazepines) call into question both drivers' aptitudes and temporal fitness to drive. For example, neurological disorders and dementia are a particular problem for older drivers. But accident analyses that go beyond clinical studies and make sufficient distinctions as to age are still lacking. With regard to the requirements for the cognitive capacity

that is necessary to drive a car (such as reaction and attention or perception functions), there is a greater likelihood of that deficiencies that tend to cause crashes are possible, but this is not necessarily the case. Moreover, older drivers are known for different types of compensatory behavior that has been shown to result in fewer accidents, for example at night.

Legislators, as well as the majority of traffic experts in Germany, therefore do not currently see the need to restrict the issuance of driver's licenses, particularly with regard to older drivers, for example by imposing time limits on driver's licenses or requiring examinations without a specific cause ("mandatory testing") (also according to the official final statements of the German Verkehrsgerichtstag traffic law conference, 2009). Instead, voluntary, self-regulating measures are considered more beneficial.

6 Political and societal approaches to a solution

"Design for all"

Many demands are placed on politicians, the trade associations, industry, and the sciences in Germany and Europe and they have proposed many different solutions but, as described above, these cannot always be in the individual interest of all road users. However, experts agree that individual efforts will not be successful without new models for action which include older road users as a target group (BASt, 2000). Based on principles used in police efforts to improve traffic safety, Dienel (2000) formulated new models for supporting older road users in their everyday life at the European *More Road Safety for Senior Citizens Conference* of the Federal Highway Research Institute. No measure to improve mobility can be taken in isolation based only on road traffic, so his technical analysis focuses on the "barrier-free" model and "design for all." Design for all means no technology for older road users alone, no crossing street design for older people alone, and no "retiree's cars," but rather design that can be used by and is most usable to everyone. Standards for designing convenience and safety functions should be unrelated to age. It must be possible to adapt operating and control units – whether at pedestrian crossings or on the dashboard – to changing users, to changing user's age and needs.

At the same time, many demands aimed solely at remedying deficiencies in the safety and convenience of older people are currently being discussed. Mobility studies have repeatedly confirmed that they can be aimed at very specific and simple needs that fall through the cracks of larger strategic considerations and political decisions, such as a lack of places to sit down and rest, too short traffic signal cycles for the elderly pedestrians, or inadequate high speed of moving sidewalks and escalators, which don't make it any easier for pedestrians whose walking mobility is limited to do without a car, including in towns and cities. The European Union's SIZE project (2006) did an expert analysis on this for several countries (Figure 111). It showed that the quality of mobility for older people suffered due to the lack of such simple things as public restrooms (which began to disappear from the cityscape since the 1980's for cost reasons).

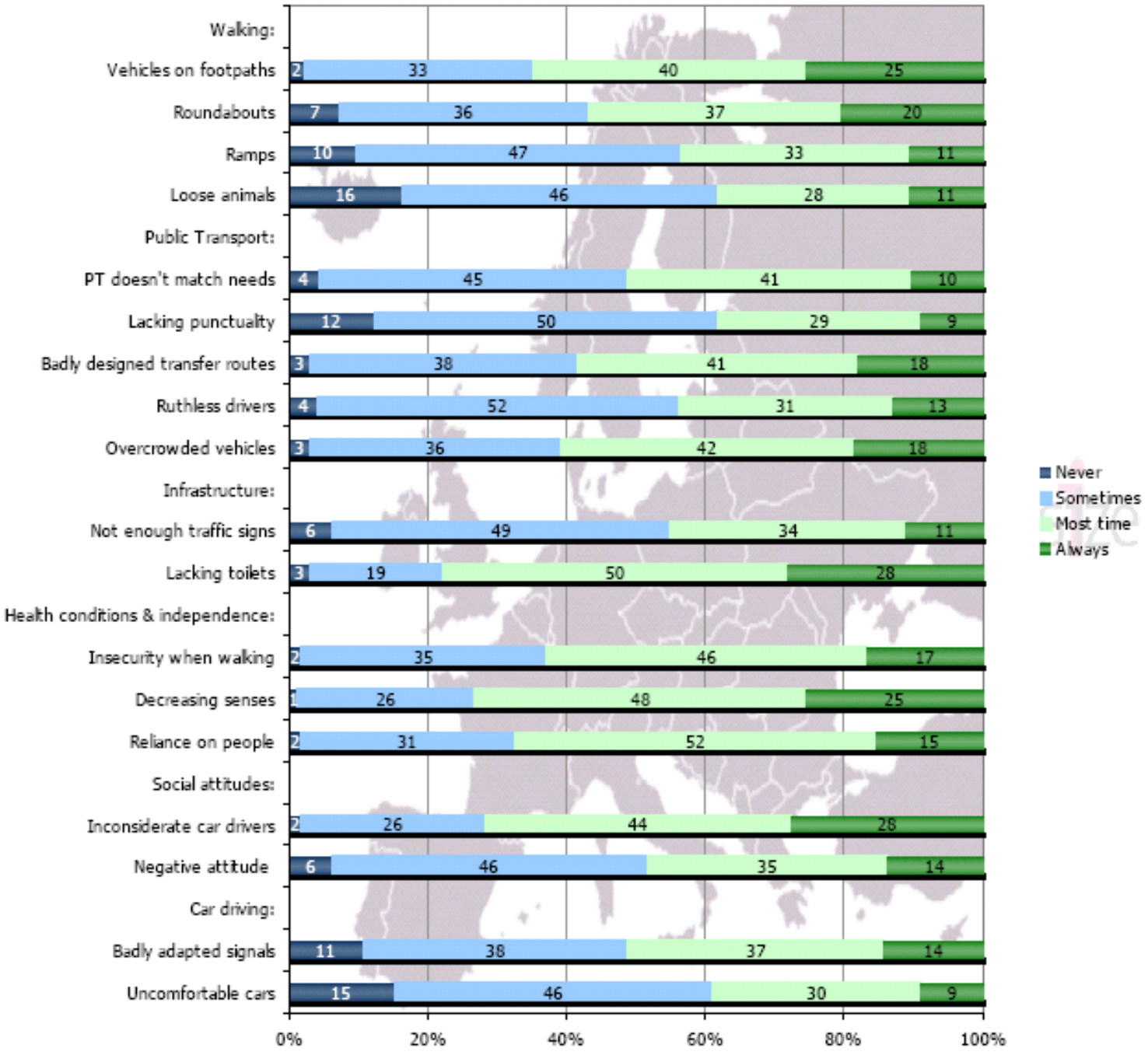


Figure 111: Factors that limit the quality of mobility for older people according to an EU expert analysis in Germany, Austria, Italy, Ireland, Spain, Sweden, the Czech Republic, Poland, and Sweden (SIZE, 2006, graphic cited according to SIZE, 2006)

Designing public space to meet the needs of people who are visually impaired is also a cost factor that is rarely accepted. Echterhoff (2004) implemented their requirements in a project "model road" for the Federal City of Bonn. However, the requirements for public space of people whose mobility is limited, as well as older people who are not subject to limitations, are also reflected in the aforementioned EU analysis under the phrase "not enough traffic signs." This relates primarily to making it easier to find one's way around, either on the road

or in public buildings. The familiar discussion about designing and managing buses in public transport to meet the needs of older passengers also shows the dilemma between the quality objectives of staying on schedule or economic efficiency on the one hand and the objectives of convenience and safety for the elderlies on the other hand. Inconvenient schedules, crowded buses, or falls due to sudden stops and starts because drivers are under time pressure are problems related to the seniors' lack of acceptance for public transport which have been identified but not solved to date for cost reasons. The need to maintain, if not improve, public transport connections for suburban areas was mentioned at the beginning of this report. At least a rivalry of transport goals within all private and business road users still hinders solutions best for seniors.

Best practices?

The *More Road Safety for Senior Citizens* conference of the Federal Highway Research Institute which was mentioned above also attempted to formulate best practices, but ultimately could present only the familiar safety campaigns and target group strategies. Lists of measures to be taken are efficient only when they are tailored to the needs and crash situation in a region or district of a city (according to the principle of "think global and act local"). The difficulty of granting the wish for a list of best practices is shown by fact that the otherwise very progressive Scandinavian countries (two of which presented their campaigns for older people to the conference under the heading of best practices) are laggards in the European ranking of annual mortality rates for older people (see section 4.2). Denmark and Sweden have imposed license restrictions on older drivers, but they are among the countries with high percentages of older car driver fatalities within all transport modes used by seniors, and are even ahead of all four EU countries without restrictions on driver's licenses (see sub chapter drivers' license below). Finally, best practices also require agreement of the objective to be achieved, which, as was repeatedly stated, is not an easy matter, starting simply with underlying methods to measure accident ratios. National or federal mortality rates does not say everything about the seniors' needs in individual local communities.

The SIZE project of the EU (2006) nonetheless did prepare a priority list of useful measures to promote the safety and mobility of older people in all types of road use (Figure 112).

Solution	Code	Rank	% Ex-perts
Introduce greater enforcement of speed restriction to reduce pedestrian crashes	S1	1	82,9%
Facilitate the adaptation of houses and public buildings	S5	2	82,2%
Introduce more low-floor vehicles: buses with low platforms and kneeling buses	S4	3	80,2%
Improve the conditions of pavements (removal of unnecessary obstacles, unevenness…)	S2	4	78,7%
Make public transport stops more accessible and comfortable	S10	5	74,6%
Introduce more urban pedestrian paths (itineraries specially designed to pedestrians)	S13	6	69,9%
Reduce the distance of pedestrian crossing (maybe introduce a resting spot in the middle of the crossing)	S14	7	69,7%
Increase the number of seating areas/resting spaces in public places	S9	8	69,2%
Introduce campaigns in order to make people more aware of the problems of older adults, thereby improving consideration and cooperation	S7	9	67,4%
Increase the sense of security and safety of older people (extra police presence, security cameras at public transport stops and stations)	S3	10	66,1%
Install traffic lights that would facilitate the mobility of older people (sonorous or visual signals: like numbers…)	S11	11	61,8%
Prolong the crossing time at some traffic lights and pedestrian crossings (green-times) for pedestrians	S8	12	58,7%
Adapt road illumination to the conditions of older adults	S15	13	54,8%
Reduce the cost of public transport (including taxis) or introduce free public transport for older people	S6	14	51,7%
Allow older drivers to retain their licenses without age limits although introducing proper restrictions (type of road, area, hours, medical-psychological checks,…)	S19	15	42,9%
Nominate a "senior Citizens" Representative (or Campaigner) to each level of Administration (municipal, councils,…, EU government)	S12	16	40,7%
Provide possibility of carrying a mobile phone	S16	17	35,5%
Provide specific legislation related to older adults	S17	18	35,1%
Allow senior drivers to use the parking places reserved for disabled people (or to reserve other special and adapted places for them)	S18	19	33,9%

Figure 112: Promoting mobility of older people: The European ranking list of solutions according to SIZE (2006)

Not surprisingly, measures to control speed are ranked highest, particularly to reduce the extremely high rate of accidents involving older pedestrians all over Europe. The Verkehrsgerichtstag traffic law conference (2007) recognized the need to call for these measures, which are effective in improving traffic safety by better enforcing existing speed limits, particularly at accident black spots (see also GDV, 2007). The harmonization of great differences in speed within and between modes of road use is another area that experts agree on and often point to as an important way to improve the safety of older road users. The research and development project on sustainable regional, urban planning and traffic (development) planning (RAVE, 2004) of the German Federal Ministry of Transport, Construction, and Housing concluded that reducing maximum speeds, including by means of a speed limit, would specifically facilitate mobility and driving by older people (RAVE, German Federal Ministry of Transport, see the chapter on background conditions). The same view is expressed by the project on older people in the future road/vehicle/human safety system (AEMEÏS, 2001) of the Federal Highway Research Institute (2001), the Swiss Council for Accident Prevention (bfu, 2007), the Swiss Federal Road Office (2008), Limbourg & Reiter in Flade, Limbourg & Schlag (2001), Beckmann, et al. (2005), and Ackermann & Gerlach in Echterhoff, 2005. In addition, Schlag & Megel (2002), in the study on mobility and societal participation in old age which was published by the German Federal Ministry of the Families, Senior Citizens, Women, and Youth, also refer very clearly to the connection between the speed factor and both active and passive safety, for example in 30 kph zones, as a measure to prevent pedestrian and bicycle crashes.

Driver's licenses

In addition to regulating and sanctioning driver behavior in general, the right of older people to use the road by motorized driving is itself usually the main focus in disussions. As said before in the section on drivers' aptitude, the German federal government currently does not see a need to take action in this area. But this question is not being answered in the same way in all Member States of the European Union. Only four countries (Germany, Belgium, Austria, and France) grant class B (car) licenses to their citizens with no time limits. It will not be possible here to discuss the specifics of limitations to the validity of other driver's license classes and permission to transport passengers – these are similarly limited throughout the EU and, depending on age, subject to certain additional examinations. The details are documentted in the EU Official Journal (2002).

Effective with the year 2013, all EU licenses (class B, car) will be limited to 10 years (15 years, if a country will decide so). Circumstances of renewal are subject to the countries' decision, too. Quite now, the majority of member countries in Europe limit the validity of driver's licenses. The age limits vary, frequently ranging between ages 60 and 70. That is followed by a time-limited renewal (at intervals of 1 or 5 years, for example), subject to a (usually rudimentary) physical examination. The benefits (and the misuse) of this testing is disputed. An assessment, let alone an evaluation, of the systems is not currently possible. The European Community is looking into this at the present time. However, two things must be remembered: With regard to medical examinations in the area of heavy goods traffic or the group 2 driver's license classes, even the license authorities in Germany (e.g. license offices and German Federal Freight Transport Agency [*Bundesamt für den Güterfernverkehr*]) complain that the existing test measures required for renewal of a driver's license are not sufficiently reliable (discussion of experts at AZT-Automotive GmbH – Allianz Zentrum für Technik, Fastenmeier, Gstalter & Kubitzki, 2007). The examinations that are used in most places in Europe are limited to rudimentary aspects of physical health which do not reflect the complexity of the psychological and medical preconditions for safe driving or its related parameters respectively, as well as the actual accompany circumstances that cause crashes. All voluntary approaches used in Germany quite now (medical psychological advise, see later) are more discerning.

The question of whether imposing an age limit on driver's licenses can reduce crashes is difficult to answer. It has already been said that the percentage of older driver is high in both Denmark and Sweden. In contrast, it is lowest in Greece and Spain. But the mortality figures do not distinguish between the age of the driver who caused the accident (at-fault data are not comparably collected throughout Europe) and, in addition, the dislocation effect of the selection[13] by older drivers on the use of other unsafe transport modes (walking/bicycle) would have to be examined (Greece has one of the lowest percentages of older car driver fatalities but one of the highest percentages of older pedestrian fatalities). Finally, it is possible to rank countries with and without driver's license age limits only if reference data (such as car availability and mileages in the age classes) are available. The lowest percentages of older drivers among car driver fatalities in Greece, Spain, and Portugal will also be attribu-

[13] The term "driver selection" is not desirable from a historical point of view, but is unfortunately used in this context, as counterpart to "driver improvement"

table to economic data for older citizens of those countries. Coming up in the rear is Italy, with the EU's highest percentage of older car driver fatalities and older pedestrian fatalities, as well as an age limit for driver's licenses. Germany, with no age limit and no examination, is right at the statistical mid-point in the EU comparison of senior fatalities. Finally, it should also be mentioned with regard to driver's license systems that in the case of a reduced fitness/-aptitude to drive, a driver's licenses subject to restrictions (such as by time or radius) can prevent the threat of complete loss that would otherwise apply (see suggestion 15 of the SIZE list of solutions). In that context, the term "senior citizen driver's license" is often misunderstood by the public as a discrimination.

Voluntary measures for drivers

Voluntary medical-psychological mobility checks based on examinations in individual cases can already point to a good tradition in Germany (e.g., DEKRA, 2008; TÜV, 2008), although there is some anxiety about these services. It is frequently adult children who talk their parents into using such services. Unfortunately, it is possible that some unfortunate terms such as "senior citizen's inspection" are not really helpful, giving similarity to the business responsible for vehicle inspection and certification. In some cases the term is used for the desirable "test acceptance" of various systems, models, conditions, or objects for their "suitability for older users," but there is no common sense, and as a matter of course, nobody likes to get inspected – and obviously no one wants to be "put through their paces" before the technical inspection staff. It has already been discussed elsewhere that buzz words like this (or senior car) rarely help to reach objectives. The experts terminology refers to "*mobility advisory services*" and "*mobility checks*." Depending on the issue concerned, advisory services could also be interdisciplinary (involving medicine, psychology, and engineering, for example with regard to conversion of a car due to restricted mobility). In communication with the public, it is important to stress that this is strictly private and confidential. Results of a consultation and examination will and must not be given to third parties. Older drivers are and remain in control of their own test data. Older citizens have some misplaced fears about this, too. On the other hand, the financial aspect should not be neglected, because a voluntary examination is subject to moderate costs. However, it is the way individuals will receive that service they actually need to clear their individual situation, for example, with regard to the issue of reaction time and perception performance while being treated or taking long term medi-

cations. Mandatory measures could not achieve this level of voluntary examination with reference to traffic psychology and traffic medicine, for they use to be minimal consens.

Non-individualized advisory and information services, such as the "*sicher mobil*" traffic safety program for senior citizens of the German Road Safety Council DVR, offer valuable assistance, for they also fulfill a "*door opener*" function and resolve people's doubts about seeking additional help. *Sicher mobil* makes drivers aware of the relevant problems growing older can cause for road use. DVR offers this to people over age 50 so that road users can be proactive in dealing with changes that often occur very gradually. But it cannot be denied that this very broad age range combines very different problem situations and, above all, can discourage the older elderly with more serious mobility problems from participating. Further dividing the DVR advisory services into groups based on specific needs or problems (not based on different age groups) would be worth discussing.

The information provided to family practitioners by the Federal Highway Research Institute (Henning, 2007) also helps to increase awareness. Family practitioners are given guidelines for understanding the issue of driving and illness in older patients. In that respect, family practitioners, who are trusted third parties, can also be important as "door openers." The physiccian can refer a patient for more extensive mobility checks in the somewhat infrequent but critical situation in which a patient has obvious difficulties. In contrast, the technical discussion about car driver training measures is still ongoing and more research is needed, as shown by the feasibility study at the University of Wuppertal (Poschadel & Sommer, 2007). Training in the very complex problem areas of physical and cognitive functions in older drivers requires a solid technical concept based on comprehensive cognition theory, and this cannot be based on a single intervention. Instead, it requires regular interventions, because merely controlling a vehicle is not the central problem of older drivers. Should older drivers deliberately practice how to master cognitively-challenging driving situations or deliberately avoid them? The methodical conflict quickly becomes evident. Whenever possible, older drivers themselves avoid stressful situations where crashes tend to occur. It is disputed whether exercises should be used to counter this. For the sub-group of older drivers for whom this question should be answered in the affirmative, Gstalter (2005) describes from the scientific viewpoint the prerequisites for training which, in accordance with the feasibility study, should be conducted on an individualized basis (not in groups). Anyway, the development of senior driver training measures is under progress, but not yet a given solution for all senior drivers.

Seniors' safety as a matter of concern for all road users

Finally, all *public relations work* on traffic safety must deliberately address *all* road users (including young people), particularly *all* drivers. Their carelessness or failure to understand the problems of older people is behind most crashes involving older people – as well as behind most troubles derogating the quality of mobility. The experimental studies cited above are to commemorate here, showing that hesitant older pedestrians – even at zebra crossings – are simply ignored (see SIZE, 2006, "ruthless drivers" factor, and compare the percentage of people involved in crashes at pedestrian crossings every year). Hesitation is misinterpreted by car drivers as ceding the right-of-way.



(DVR photo)

Vehicles and their advanced assistance functions

Section 4.3 described the benefits of advanced driver assistance systems from the viewpoint of Allianz accident statistics. Several EU research projects over the past few years have explored the potential benefits of new vehicle technologies to support drivers. The benefits for older drivers were summarized in COST Transport (2006) (Figure 113). This clearly shows the benefit of systems to process information in complex driving situations (a benefit at least for all age groups, as shown by the data on the age distribution of accident types in Germany). In contrast, COST did not address the potential negative effects of temporarily relinquishing a driving task, since automation cannot be available in all driving situations or during the entire trip. The driver therefore does not regularly handle these specific driving tasks, and they are more rarely carried out independently; however, from a legal viewpoint no driver can rely solely on complete takeover of functions by the system (when the system is doing more than

supporting vehicle stability, but supporting driving maneuvers). Unfortunately, there are hardly scientific findings on this. They can be obtained only from longitudinal studies, and further research need is obvious.

In-Vehicle Technology	Potential Benefits for older people
Collision Warning Systems	Task-load decrease: Automate much of the driving process Prevent a potential accident, as it may: - alert the driver of a hazard - adjust headway (following distance) - fit the driver's difficulties in turning left at an intersection Driver assistance to cross complex intersections Driver confidence increase
Adaptive Cruise Control	Task-load decrease: Adjusting headway (following distance) Relieving the driver from distance assessment and ahead vehicle speed assessment tasks Increase system capacity and efficiency Minimize headways while maximizing safety (without them, elderly drivers may decelerate because of fear, leading them either to drive slower, or to increase the following distance or both
Emergency Alert Systems or Automatic Vehicle Location	Increase safety (rural areas) Increase driver confidence
In-vehicle route guidance and navigation	Increase driver confidence Availability and accessibility of information Increase mobility More destination options
Vision Enhancement Systems	Increase driver confidence and mobility Allowing elderly drivers to drive at night or in adverse weather conditions
Automated Lane Changing and Merging Systems	Provide assistance for difficulties in information processing Assist the driver in selecting a headway, taking care of the actual changing or merging
Blind Spot and Obstacle Detection	Provide support on the detection of objects close to a slow-moving vehicle
In-vehicle signs and warnings	Ease information detection Projection of signs and warnings from the roadside

Figure 113: Advanced driver assistance systems in the vehicle: Potential benefits for older drivers (COST Transport, 2006)

Reference has already been made to the need to weigh theoretical benefits in a way that is appropriate for all ages. The design, layout, and configuration of any vehicle system and the operation of such systems while driving should all be appropriate for the requirements of older age groups (see INVENT, 2006); this is not limited to the legibility of the display characters. Fastenmeier (2003) states in that context that the use of systems must be self-explanatory. The EU's HUMANIST project (2005) calls for learning opportunities when using modern vehicle technologies which will also be oriented to older drivers/users and take into account the cognitive training and skill development of different age groups. ADAS usage needs to be adapted to senior users.

Specific suggestions for following barrier-free principles have long been made where vehicle configuration is concerned, for example ensuring optimum visual or seating conditions or improving the sill height of the passenger compartment or liftover height of the trunk (see Koch, 2008). This principle also applies to designing bicycles for ease of use by older riders (Draeger & Klöckner, 2001). This includes easy mounting, a simple carrier device, vibration-free mirror, turn signal, and more.

In contrast, one further critical aspect relates to the relationship between age and the effect of *passive* vehicle safety functions (such as airbags). In the field of vehicle technology, the design of the systems and the associated test methods or simulation models are based on the inclusion or exclusion of a defined percentage of the total distribution of a specific feature (such as the car occupants' height or weight) in the average population. "Marginal" people (for example, those who are very tall or very short) are not taken into account. But as the age pyramid shifts, the percentage of particularly small older women car passengers, for example, will increase; this is a group that is more likely to be involved in fatal crashes due to their greater vulnerability, as seen before.

The advantages of a technical system for preventing accidents are one thing. The acceptance and the ability of target groups even to use new technologies is quite another. Gerontology and traffic psychology distinguish between *t-rich* and *t-poor*. According to this, the current generation of older drivers has not been accustomed to using certain technical innovations from the time they were young. Surveys among professional drivers show that, for example, as truck drivers age, they increasingly refuse to use assistance systems that can require additional manipulations (including hands-free telephoning while driving). That may change with

future generations, of course. However, the age-specific (not cohort-specific) aspect of decreasing motivation to use technical innovations as age increases should not be underestimated – *t-rich* and *t-poor* are also to be understood as user types who are or are not open to technology. Brandt & Voß (2002) showed in the senior technology project that *openness to technology* and customers' purchase behavior can vary considerably as a function of personal circumstances. It cannot be the case that motor vehicles of tomorrow are sufficiently safe for older drivers only if fully equipped with latest assistance systems. The future will show how coming generations of older road users will cope with a future telematic traffic system that includes vehicle-road-vehicle-vehicle communication. In any event, the latter is not being pursued in a way that includes knowledge from the field of gerontology.

Only a brief reference can be made here to the many points of discussion related to making roadways more friendly to older users. The example of the need to optimize traffic circles or roundabouts, which are otherwise rated as positive for road safety, from the viewpoint of older users shows just how multi-faceted this problem is. Older people have trouble with multi-lane traffic circles; Lord, et al. (2007) describe the need for improved layout of lanes and for signage. The width of bicycle lanes is criticized as not being appropriate for older users (Draeger & Klöckner, 2001). The conflict of interests can hardly be clearer than it is in the discussion on designing roadways for ease of use by specific groups. Safer mobility of older people will not be achieved without curtailing economic efficiency (fast flowing traffic) (particularly according to the German Transport Ministry RAVE project, 2004). And it cannot be denied that most experts and the majority of case law place far more emphasis on the intriguing issue of the rights of four-wheelers, go-carts, inline skates, and motorized scooters than on the serious and growing issue of motorized wheelchairs[14] and the roadway needs of people using rolled walkers (known as rollators), which are not motorized.

Fortunately, a lot of traffic experts today agree that future urban and town planning and road building will have to be better adapted to the changing societal structures and needs of the different age groups.

[14] And it is precisely in this area that the transition to light (four-wheeled) vehicles (for class S license), which are extremely dangerous to their occupants and primarily purchased by older people, has become very vague – both according to the legal definition and in the trade. Differences between light cars and motorized wheelchair shrink. The motorized wheelchair sector also anticipates a considerable increase in demand (Brandt & Voß, 2002).

Outlook

Both politicians and civic groups are active in this area. Even when mobility interests collide, there will be advocates for future concerns of older people in the transport systems. A recent EU-wide program to promote mobility and transport services for the elderly (MOVE AGE, 2007), which is supported by the German federal government, will network different national and international projects to improve the safety and quality of life of older road users.

The safety of the elderly is emphasized in the publications of the European Transport Safety Council (ETSC), the partner in this study on older road users. And the German Insurance Association (GDV), Allianz Versicherungs-AG, and AZT-Automotive GmbH – Allianz Zentrum für Technik also consider issues of concern to the elderly to be some of the most important items on their agendas. The loss prevention commission of the German insurance industry and AZT-Automotive GmbH will also continue to promote the safety measures and projects targeting the needs of older road users. AZT-Automotive GmbH has made that commitment in the context of the European Road Safety Charter.

7 Older road users – Conclusions

No matter what models are used to project the trends for road use or for mileages in the various kinds of transport modes, experts agree that the number of older road users will increase. Those models indicate a clear increase in the percentage of older road users out of all victims of traffic accidents in Europe – to one-third of all fatalities by 2050, as the European Tranport Safety Council has noted.

The aging of society due to declining birth rates affects every country in Europe, including the mostly-Catholic southern and eastern European countries. Regions that today are experiencing serious problems with crashes involving older people will have to cope with a further deterioration of their safety situation – and this includes countries and regions whose efforts to improve traffic safety and whose vehicle and road traffic technology are based on a long tradition of quality, such as the Scandinavian Member States. Aside from the individual characteristics of each country, it must also be emphasized that the mere fact that older road users are exposed to a significantly higher risk of dying in *all* European Member States makes it urgently necessary to take additional counteracting measures. As an example, it has been seen for Germany that older people also benefit from the multi-year trend of increasing general safety on the road, but they always lag behind the middle-aged adults to an extent that is apparently fixed. This difference, which is attributed to greater vulnerability, cannot be used as an excuse and must be taken as an incentive for strengthening senior safety efforts.

This is also shown by most of the traffic accident data: Older people are "victims" ("at risk"), not "perpetrators" ("risky") when they take to the roads. They are far more likely to be killed in crashes in which they are the so-called "weaker road users" – pedestrians and bicyclists. They are also more likely to die as a passenger in a motor vehicle than younger people are. Even the issue of car mileage related road risk of older drivers must be examined in light of more sophisticated analyses. Older people are at fault in fewer car crashes with casualties than young drivers and novice drivers, even at older senior ages. Certainly the senior drivers crash rates rise compared with people in the 25-64 age group and also increase considerably among the older elderly; this trend is also observed in the claims submitted to the insurers. But the considerable inter-individual differences between drivers and the assessment of each

individual case must not be neglected when considering the mandatory driver's licensing requirements that are so often called for. With regard to crash rates based on car mileages, groups who travel the same annual mileages should be compared with each other. This is rarely done due to a lack of underlying data. So much for general statistical considerations.

It cannot be denied that as older road users age it is in fact age-correlated physical and cognitive impairments that are more likely to lead to culpable involvement in crashes than in younger years. Neither can it be denied that the legal requirements for the driver's licensing system specify minimum standards for the competence (aptitude) to partizipate in motorized traffic, and if they are not fulfilled the authority must withdraw the driver's license. Specific clinical pictures and the intake of medications, age-related changes in psychological functions such as attention, perception, or reaction time, and, not least, increased uncertainty in difficult, complex, and stressful situations on the road – whether as a driver at an unclear intersection or as a pedestrian on a road without a designated crossing – are a challenge for efforts to improve road safety, irrespective of what risk is measured. Older people solve many mobility problems themselves by deciding not to use the road. But they also have a right to mobility. That raises the question of both fundamental requirements for society as a whole and simple and practicable solutions that can be implemented today.

Assistance for older road users

- Freedom of choice

  The quality of mobility and therefore the quality of life of older people is measured in terms of their freedom to choose a transport mode based on their own needs and requirements. The continued ability to be mobile by driving a car or walking and using public transport in old age should receive ongoing support. Above all, older people should not lose the ability to take public transport in rural and suburban regions. Enhanced regional transport that meets the needs of older people is indispensable.

- The "design for all" philosophy

  The world of transport must offer all age groups the best possible way to actively and passively use the different modes. Urban planning and road construction measures (such as the configuration of traffic circles), ergonomic design of vehicles or assistance

systems (such as displays), or the design of passive safety systems such as airbags or impact protection in a vehicle must take the needs of all age groups into consideration.

- Older pedestrians and bicyclists are the main target group

  Updated educational efforts and increasing the awareness of all road users about the particular accident risk of older people who walk and ride a bicycle should be an integral part of safety campaigns, and not just periodic topics.

- Principles of "*seeing and being seen*" for all road users

  Irrespective of any determination of fault, everyone can act in accordance with pragmatic old saying in the area of road safety, which is that all road users should make sure they can see and be seen as clearly as possible. This can involve a vision test, light test, visible clothing, clean reflectors, or proper equipment on a bicycle – none of these aspects ever seem to lose their relevance.

- Driving defensively

  Crashes involving older road users can be avoided if all drivers act defensively and follow the rules. This applies particularly to drivers' speed on through streets in towns and cities, at pedestrian crossings, and at unclear intersections and also includes accompanying enforcement measures and helps make everyone safer.

- Technical support

  Warnings, an environment that is designed to meet the needs of people who are visually impaired or physically disabled, and future assistance functions for drivers (e.g. recognition of pedestrians and bicyclists) should be updated and further developed.

- Older drivers

  Older drivers benefit from assistance systems that support them in performing complex driving tasks (crossing intersections, emergency braking). Systems and principles that offer greater convenience also promote safety and, moreover, improve the

quality of mobility (a key example is a trunk sill). Targeted efforts to educate seniors about equipping vehicles for safety is thus also part of advice on mobility.

Voluntary advisory services on mobility and advisory programs for older road users in general, as well as older drivers in particular, will promote early detection of individual risks and, where applicable, the implementation of useful ways to promote mobility. More precisely targeted efforts to increase the awareness of older drivers should make them less skeptical about "mobility checks." Advantage should be taken of multipliers elsewhere in the community (such as family practitioners, community workers, and the media) to promote the awareness of everyone concerned.

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Annexes

Annex 1

Country abbreviations

EU-14

BE	Belgium
DK	Denmark
EL	Greece
ES	Spain
FR	France
IE	Ireland
IT	Italy
LU	Luxemburg
NL	Netherlands
AT	Austria
PT	Portugal
FI	Finland
SE	Sweden
UK	United Kingdom

EU-18 = EU-14 +

EE	Estonia
HU	Hungary
MT	Malta
PL	Poland

EU-19 = EU-18 +

CZ	Czech Republic

EU-27 = EU-18 +

BG	Bulgaria
CZ	Czech Republic
DE	Germany
CY	Cyprus
LV	Latvia
LT	Lithuania
RO	Romania
SI	Slovenia
SK	Slovakia

Annex 2

Fatalities and at-fault rates in relation to registered cars and class B driver's licenses

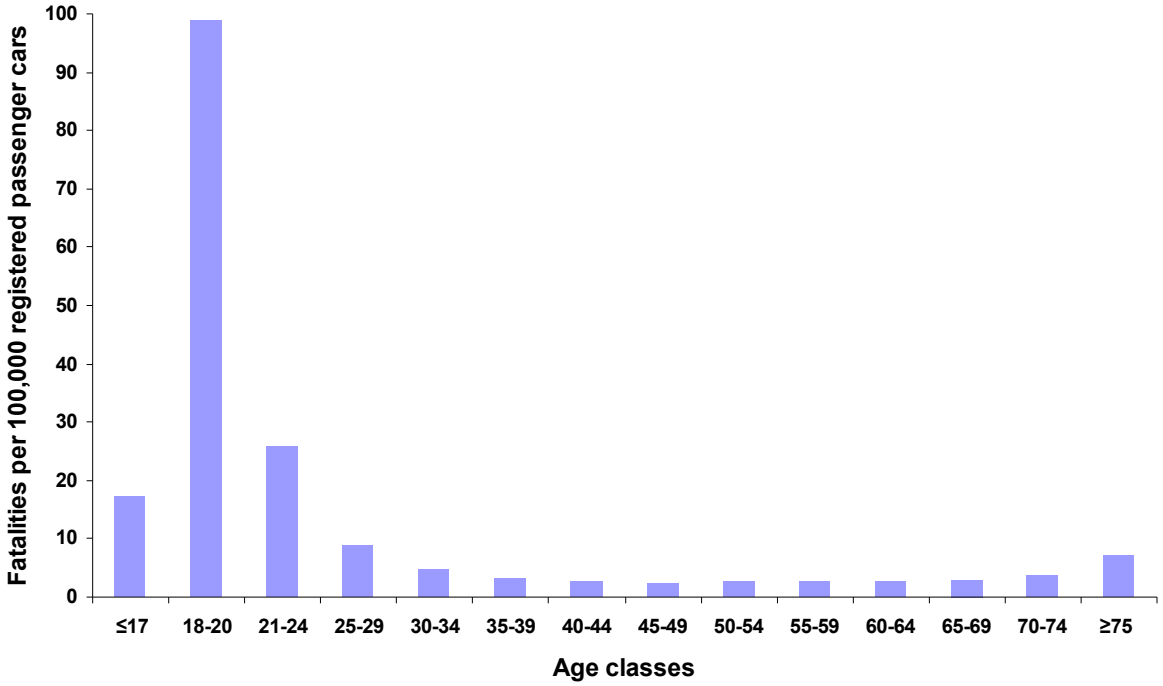


Figure 114: Car driver fatalities by age per 100,000 registered passenger cars in the individual age class, 2006 (Database: StBA and KBA, 2007). The graphic clearly shows that young car drivers die in vehicles that are obviously registered to older people.

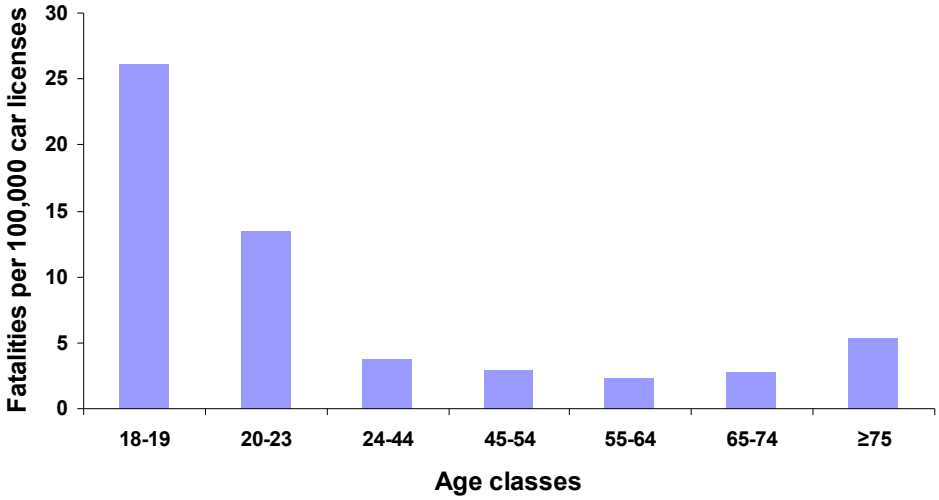


Figure 115: Car driver fatalities by age per 100,000 class class B driver's licenses in the individual age class, 2004 (Database: StBA, 2005, and BASt, 2007)

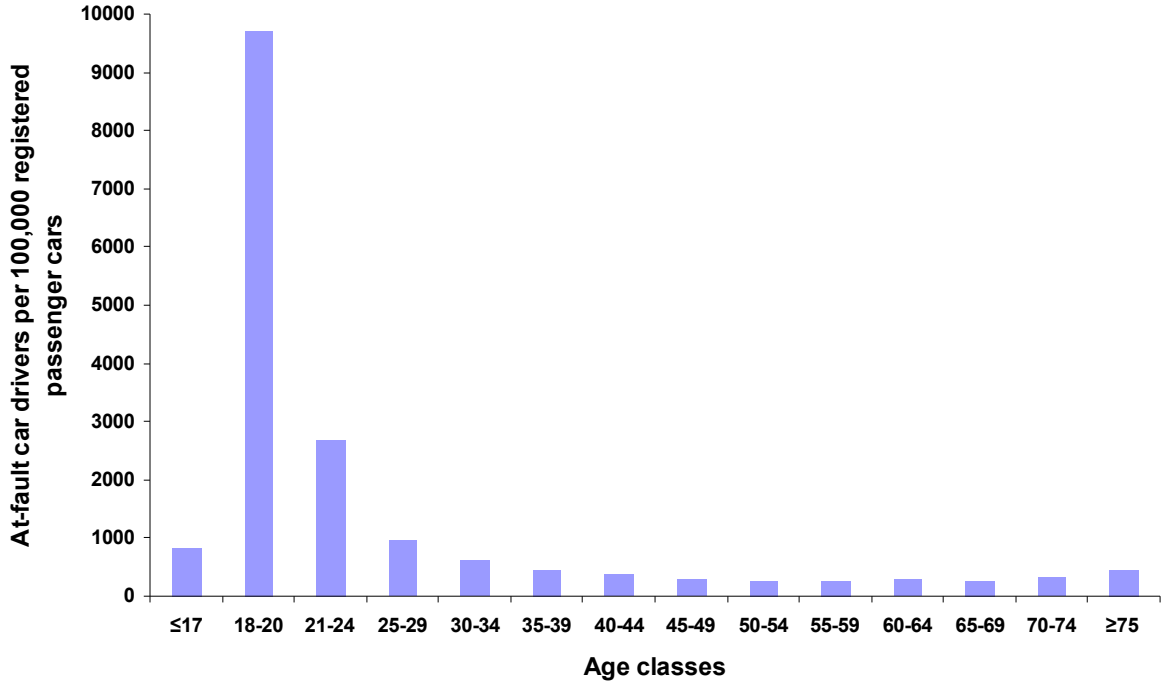


Figure 116: Car drivers at fault in injury crashes by age per 100,000 registered passenger cars in the individual age class, 2006 (Database: StBA and KBA, 2007). See comment on Figure 114

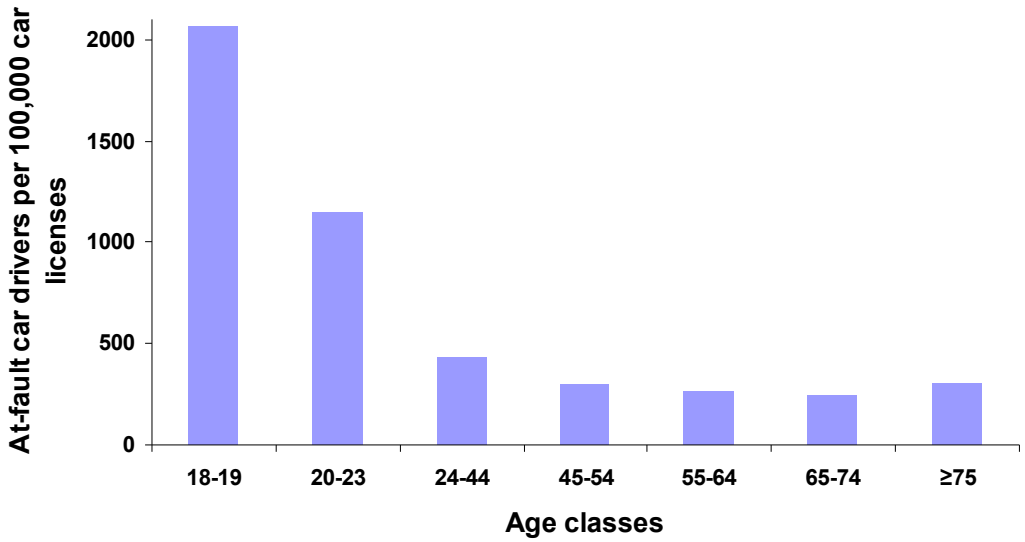


Figure 117: Car drivers at fault in injury crashes by age per 100,000 class B driver's licenses in the individual age class, 2004 (Database: StBA , 2005, and KBA, 2007). (Note: Due to different age classes, the at-fault drivers aged 18-20 and 21-24 were averaged for their age group and reallocated, which can only provide a rough indication. It is likely that the bar for 18-19 should be a bit higher to the detriment of 20-23, while the column for 20-23 should be marginally higher to the detriment 24-44).

Imprint

Safety and Mobility of Older Road Users
February 2009

Publisher
Allianz Deutschland AG
Fritz-Schäffer-Strasse 9, D-81737 München

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